WERE DO THEY GET THEIR PROTEIN FROM?

Dietary nutrient intake of children in Helsinki day-care centres eating either vegan or omnivore meals

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Master's Thesis
Nutrition Science
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University of Helsinki
November 2019

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Title

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Subject

Nutrition Science

Level	Month and year	Number of pages
Master's thesis	November 2019	94

Abstract

Background: A few Finnish municipalities have chosen to offer the option of a vegan diet at day-care if the parents request it. The food offered at day-care plays an important part in a child's nutrition and should be guided by official recommendations. As little evidence exists for the adequacy of a vegan diet for children in day-care more studies on the subject is needed. The food provided by the day-care should cover 2/3 of the daily energy requirements and the quantity of saturated fat, salt and sucrose should be limited.

Aim: The aim of this thesis is to compare and analyse the nutritional adequacy of vegan and omnivore meals offered by the municipality of Helsinki. Additionally, to describe the dietary sources of intakes from both meals.

Data and methods: This thesis is part of the MIRA Helsinki study, conducted by the University of Helsinki. The objective of the project is to study the impact of a vegan diet on the nutritional status of children in day-care in Helsinki. The data for this thesis was collected through food diaries. The children range in age from one to six years and are divided into two groups based on meals eaten at day-care, vegan meals (n=9) and omnivore meals (n=16). All statistical analyses were done with the SPSS program (version 25).

Results: In most cases the dietary intake followed official recommendations. Of concern is that salt intake was high in both groups. The two diets provided similar amounts of energy, carbohydrates and sucrose at day-care. However, protein ($p<0,001$), fat ($p=0,008$) and fibre ($p<0,001$) intakes were significantly more favourable when eating vegan meals. The group eating vegan meals also had a higher intake of monounsaturated and polyunsaturated fat ($p=0,007$; $p<0,001$) as well as linolenic acid ($p<0,001$) and α-linolenic acid ($p<0,001$) in comparison to the omnivore group. Further, the omnivore group had higher intakes of cholesterol ($p<0,001$) and saturated fat ($p=0,007$). There was no dietary intake of EPA and DHA in the vegan meals. Intakes of saturated fat and cholesterol outside the day-care were higher than at day-care. The vegan meal group had significantly higher intakes of folate ($p<0,001$), iron ($p<0,001$) and zinc ($p=0,001$) while lower intakes of iodine ($p=0,006$) and calcium ($p=0,01$), were noted in comparison to the omnivore group. Although the intake of vitamin C does not significantly differ between the groups, the intake at day-care is low in both groups (vegan meals 38 %, and omnivore 21 % of total intake). In the diet of the children eating vegan meals at day-care, fortified plant-based milk played a central role as a source of many nutrients.

Conclusions: Because of the small sample size no general conclusions can be drawn from these results, but it seems the vegan meals have many positive characteristics compared to the omnivore meals. The results may give an insight to nutritional differences between a vegan and an omnivore diet of under school age children in Helsinki. A more plant-based diet would be a sustainable choice for the future, but supplementation is recommended to guarantee sufficient intakes of critical nutrients. More studies are needed on the long-term effects of a vegan diet on young children and the characteristics of a vegan diet in Finland.

Keywords Vegan, nutrition, dietary intake, mass catering, day-care

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Fakultet	Institution
Agrikultur-Forstvetenskapliga fakulteten	Avdelningen för livsmedels- och näringsvetenskaper

Författare

Sophia Rehn

Arbetets titel

Näringsintag hos barn som äter antingen veganska eller omnivora måltider på daghem i Helsingfors

Läroämne

Näringslära

Arbetets art	Datum	Sidantal
Pro gradu -avhandling	November 2019	94

Referat

Bakgrund: I några finska kommuner kan föräldrar be att deras barn serveras veganska måltider på daghem. Den mat som serveras på daghem är en viktig del av barnets näringstillstånd och planeringen av maten bör därför styras av officiella rekommendationer. Det finns knappt om forskningsbevis på ifall en vegan diet lämpar sig för barn på daghem och det behövs därmed mer forskning inom detta område. Maten som serveras på daghem borde täcka 2/3 av det dagliga energibehovet samtidigt som intaget av mättat fett, salt och sackaros bör begränsas.

Mål: Målet med denna avhandling är att jämföra och analysera den näringstillräckligheten av maten serverad på daghem i Helsingfors. Dessutom beskrivs kostkällorna för näringsintagen från de olika måltiderna.

Data och metod: Denna avhandling är en del av MIRA Helsinki studien, ledd av Helsingfors universitet. Projektet ämnar forska om hur en vegan diet på daghem i Helsingfors inverkar på barns näringsstatus. Den data använd i denna avhandling är baserad på matdagböcker. Barnen är mellan ett och sex år gamla och de är indelade i två grupper baserat på vilka måltider de äter på daghem, veganska måltider (n=9) eller omnivora måltider (n=16). All statistisk analys gjordes med SPSS programmet (version 25).

Resultat: Kostintag i båda grupperna följde huvudsakligen de officiella rekommendationerna. Bekymmersamt var att saltintaget var högt i båda grupperna. På daghemmet försåg båda dieterna barnen med liknande mängder energi, kolhydrater och sackaros. Dock var protein ($p<0,001$), fett ($p=0,008$) och fiber ($p<0,001$) intaget signifikant mer gynnsamt bland barn som åt veganska måltider. De veganska måltideran gav även högre intag av enomättade och fleromättade fettsyror ($p=0,007$; $p<0,001$) samt av linolsyra ($p<0,001$) och av α-linolensyra ($p<0,001$) jämfört med de omnivora måltiderna. Omnivore gruppen hade ytterligare ett högre intag av kolesterol ($p<0,001$) och mättat fett ($p=0,007$). Det fanns inga kostkällor för EPA eller DHA i de veganska måltiderna. Intaget av mättat fett och kolesterol var högre utanför daghemmet än på daghemmet. Gruppen som åt veganska måltider hade ett signifikant högre intag av folat ($p<0,001$), järn ($p<0,001$) och zink ($p=0,001$), samt ett lägre intag av jod ($p=0,006$) och kalcium ($p=0,01$) jämfört med den omnivora gruppen. Även dock C vitamin intag inte skilde sig mellan grupperna var intaget på daghemmet lågt i båda grupperna, 38 % av totala intaget i gruppen som åt veganska måltider samt 21 % av totala intaget i gruppen som åt omnivora måltider. Vitaminberikad växtmjölk var en central källa till många näringsämnen bland barnen som år veganska måltider.

Slutledning: Resultaten tyder på att veganska måltider har flera positiva karaktärsdrag jämfört med omnivora måltider. Men p.g.a. att urvalet var litet kan inga generella slutledningar dras. Resultaten kan ge en insikt i hur näringsintaget av Helsingforsbarn under skolåldern kan inverkas av en vegan eller omnivor diet. En mer växtbaserad diet är ett hållbart val för framtiden men kosttillägg bör inkluderas för att försäkra tillräckligt intag av kritiska näringsämnen. Fler studier kring en vegan diet hos små barn behövs för att undersöka de långsiktiga effekterna detta kan ha samt hur denna diet ser ut i Finland.

Nyckelord Vegan, näringslära, näringsintag, bespisning, daghem

Handledare: Maijaliisa Erkkola, Liisa Korkalo, Essi Skaffari

Förvaringsställe Helsingfors universitet bibliotek– Helda / E-thesis (avhandlingar)

Table of Contents

Attachments

List of abbreviations

ALA – Alpha linolenic acid

DAGIS - Increased Health and Wellbeing in Preschools

DHA - Docosahexaenoic acid

EPA - Eicosapentaenoic acid

LA – Linoleic acid

MIRA Helsinki - Mikroravintoaineet helsinkiläisten lasten ravitsemuksessa (Micronutrient content of Helsinki children's nutrition)

MUFA – monounsaturated fatty acids

PUFA – polyunsaturated fatty acids

SAFA – saturated fatty acids

1. INTRODUCTION

A vegan diet is becoming more well-known and the proportion of young vegan children might be increasing. The specific requirements of young children put them at a higher risk of malnutrition compared to adults in case the vegan diet is not well planned. Further, food behaviour and food choices established in childhood could significantly affect behaviour later in life (1,2). For a vegan child this could be the positive aspects of the diet e.g. less saturated fat and more dietary fibre that could lower the risk of certain chronic diseases (3). However, the impact of a vegan diet in early childhood is not well researched and there is not enough evidence to rule out any lasting negative effects.

As a majority of Finnish children are enrolled in public day-care centres it is important that the food served is nutritious and takes special requirements into account. The city of Helsinki has ruled that a vegan diet will be served in the city's day-care centres to all vegan children requesting it (4). Mass catering is an opportunity to even out differences in diet between children from different socio-economic classes. Evidence has indicated that children provided with food in day-care outside the home have a diet that is more varied and more in line with the national recommendations (5). This is a strong point to motivate mass catering as means to equality in terms of health, regardless of diet.

This thesis is a part of the Micronutrient content of Helsinki children's nutrition study (MIRA Helsinki), a study with the aim to compare the diet, nutritional and metabolic status in Finnish day-care children following a vegan or omnivore diet. In this thesis the nutritional quality of the vegan and omnivore meals served at day-care is assessed by describing the dietary nutritional intake of children eating either meals.

2. THEORETICAL BACKGROUND

2.1 Vegan and vegetarian diets in Finland

There are many variations of a vegetarian diet, depending on which animal products are included in the diet (see Table 1) (6–9). However, a vegan diet is the only completely plant-based diet, excluding all foods of animal origin. The motivation for adopting a form of vegetarian diet can be categorized into three main groups; ethical, environmental, and health (8,10). Several studies show that vegetarians and vegans most frequently cite animal welfare and ethics as reasons for their diet choice (8,10,11). Veganism is more than just a diet; it is a lifestyle choice guided by ethical principles to do no harm to other animals. For some, however, health reasons are the major determinant for following a vegan diet. Numerous health benefits have been associated with a vegetarian or vegan diet and this can motivate a plant-based lifestyle (12).

Table 1. Different categories of vegetarian diets.

Diet	Excluded food and products thereof
Semi-vegetarian	Red meat
Pesco-vegetarian	Meat, eggs and dairy
Lacto-ovo-vegetarian	Meat and fish
Lacto-vegetarian	Meat, fish and eggs
Ovo-vegetarian	Meat, fish and dairy
Vegan	All of animal origin

Finnish consumers are more aware of the ethical and environmental issues of food production and intensive animal farming than before, reporting wanting to eat more sustainably both for the environment and their own heath (10,13). One study suggests that one in five Finns have already cut down on meat consumption (14). Animal products have a larger impact on the environment than plant-based products. It is ecologically more efficient for humans to eat the cereal and nutrients fed to animals, than to eat animals fed with the same cereals and nutrients (15). By leaving out animal products either partly or completely, an individual can have a great effect on their environmental footprint. All this to say that there has been an increase in the interest of vegetarian diets in Finland during the last few years (13).

2.1.1 Prevalence in Finland

It is challenging to estimate the prevalence of veganism in Finland, especially among young children. Even though veganism has become part of mainstream media the number of individuals following a vegan diet in Finland remains low (13). A 2008 Finnish study analysing data collected in 2003-2005 on children aged 3-6 reported that 0,2-0,6% of children were vegetarian (16). The prevalence of a vegetarian diet among Finnish day-care aged children seems to be higher in the metropolitan area around Helsinki, with a prevalence of 2% compared to 0,6% in areas further away (17,18). No vegans were reported in either study.

In Finland it seems that a vegan diet is more common among adolescents than young children. However, conclusive data on the prevalence of either vegetarian or vegan diets are missing. Parviainen et al. (10) show a decrease in vegetarianism and veganism in Finnish 12-18-year-olds between the 1991 and 2001 measuring points compared to 2007 and 2013 while Jallinoja (13) state an increase in vegans from 0,3% in 2014, to 1,1% in 2016. A vegetarian or vegan diet is most popular among the adolescents and young adults, in 2015 studies among 15-24-year old Finns showed that 16 % didn't eat any meat (14,19). It is estimated that 4.1 % of the adult Finnish population is vegetarian (13,19). Roughly one percent of Finns aged 19-34 reported themselves as vegan in the nationwide FinDiet survey in 2017 (20). Finnish girls and women are more likely to follow a vegetarian or vegan diet compared to their male peers (13). This tendency is also visible in the dietary intakes of Finns, the meat and vegetables consumption among women adhere to the recommendations more often than that of men (20).

As vegan parents could be assumed to raise their children vegan, and veganism is especially popular among individuals who soon will or already are starting families, the number of young vegan children could be on the rise (11). As plant-based diets become more popular among the younger population, the concern is that children might not have a proper nutritional intake. Young children are at risk who, as they grow, require adequate nutrient intakes to develop normally and to avoid lasting negative effects on their health (2,21).

2.2 Long-term effects of a vegan diet

When eating a well-planned vegan diet in childhood lifelong healthy eating habits are learned, including a high consumption of fruit and vegetables and lower consumption of products high in fat, saturated fat (SAFA) and cholesterol (6,22). Lower prevalence of obesity, cardiovascular disease and type 2 diabetes has been reported among vegetarians than the Western population in general (3,6). In adults a vegetarian or vegan diet has been connected to lower levels of the most relevant risk factors for chronic disease (BMI, lipid variables and fasting glucose) as well as cancer (3,23). Studies have shown that vegetarian children have a lower risk of being overweight, compared to omnivore peers (6,24–26). As children with a BMI within the normal range are more likely to be of normal weight as adults this would mean significant health benefits later on in life. A higher fruit and vegetable consumption could partly explain the decreased risk for cardiovascular disease and cancer as specifically a high dietary fibre intake is associated with a reduced risk of cancer and cardiovascular disease (27–29). Not only is the risk of type 2 diabetes lower among vegetarians but a vegetarian diet is also associated with improved glycaemic control (30). Vegans tend to have lower iron stores than omnivores and as long as the stores are within the recommended ranges this could lower the risk of type 2 diabetes (9,31). High ferritin levels have been associated with an increased risk of type 2 diabetes, however the underlying relationship is not clearly understood (31,32). With cardiovascular disease and type 2 diabetes being endemic in Finland, the reduction of these diseases is especially important.

Life-long vegetarians showed no difference in height, age at menarche, body weight and BMI to those who had become vegetarians as adults (33). Two studies done in the 1980's showed vegan children having a slightly slower (<50th percentile) growth rate than the reference population (9). There is little evidence on the impact a vegan diet might have on the development of young children (34). Similarly, there are few studies on the effect a vegan diet in childhood might have on the health and nutritional status later in life. Further, there are many limitations to the existing studies on the long-term health benefits of a vegan diet, e.g. small study groups (8). More studies are needed to differentiate the health effects of a vegetarian or a vegan diet compared to an omnivore diet. Vegetarians have been shown to have a longer life expectancy compared to omnivores but the evidence of a vegan diet is contradictive (34). One study suggest that a lactovegetarian diet's effect on health might have more benefits and less risks than that of a vegan diet (35), citing good bone health as the main benefit. Further, the

health benefits associated with a vegan diet could partly be attributed to a healthier lifestyle in general (36). Less smoking and a higher level of physical activity also decrease the risk for many diseases.

Bone studies show that vegans tend to have lower bone density level than both vegetarians and omnivores; however, there appears to be little clinical significance as long as an adequate intake of key nutrients such as calcium, vitamin D, and protein is ensured (3,6,37). A vegan diet is associated with larger intakes of magnesium, potassium, vitamin K and vitamin C, that all promote bone health (6,19). Interestingly, a lower protein intake has been reported to decrease calcium excretion through urine, but no connection to calcium absorption has been made (38). Vitamin B12 deficiency has also been connected to poor bone health, and alongside vitamin D and zinc it is associated with low bone mineral density, increased fracture risk and osteoporosis (39). Vegans with low calcium intakes (<525 mg/day) have been reported to have a 30% increase in fracture risk (6). A Polish study showed that adolescents who consumed a vegan diet in early life had a lower relative bone mass than their omnivorous peers (40). An English study showed a higher bone fracture risk among vegans as compared to omnivores, pescatarians or vegetarians (37). This was explained by a lower mean calcium intake among the vegans. However, to identify one nutrient deficiency as the culprit for negative effects on bone health might oversimplify the complexity of bone regulations systems (41). A low vitamin D status has been associated with an increased risk of certain cancers (3).

2.3 Nutritional intake and status of vegan children

It is important to understand if, or how, a vegan diet effects a developing child as young children are more vulnerable to possible negative effects of a vegan diet. However, there is a lack of scientific evidence on the effects a vegan diet has on the nutritional status and health of children. No international consensus has been reached on whether a vegan diet is suitable for young children (9). There are only a few studies on vegan or vegetarian diets in children, many of which are outdated (11). Further, they tend to include small sample sizes, to be highly heterogeneous and to be cross-sectional (11). The available studies including vegan subjects below 18 years of age have been gathered in Table 2. No studies on a macrobiotic data have been included as the diet might contain fish (9). As available studies on young vegan children was lacking, studies with vegan adults have been included as reference in this thesis.

Table 2. Available studies on the diet and nutrient intake of vegan children and adolescents, from 1988-2019.

Reference	Aim of the study	Participants	Age of participants	Setting, methods	Main results on veganism
Sanders et al. 1988 (42) Great Britain	Examine physical development	39 vegans, no comparison group	1-7 years	Prospective, 7-day weighed food record	Normal growth, slightly smaller than UK average. Compared to UK average, higher nutrient density for all measured nutrients except fat and calcium. With sensible advice there is no issue raising vegan children.
Lombard et al. 1989 (43) USA	Assess carnitine status	25 vegan, 32 lacto-ovo-vegetarian, 29 omnivore controls	3-17 years	Cross-sectional, FFQ on dietary practices, urine and blood sample	Lower carnitine levels among the vegan and vegetarian children, however, still within reference values. The body is able to maintain carnitine status even with low intakes. No conclusion on the risk of deficiency among children.
O´Connell et al. 1989 (44) USA	Examine physical development	404 vegans; first two years of life 83% vegan, 14% lacto-ovo-vegetarian, 3% omnivore; no comparison group	4 months to 10 years	Cross-sectional, FFQ on dietary practices	Adequate growth even though slightly below reference population. A vegan diet can support normal physical development when executed with care.
Sanders & Manning 1992 (45) Great Britain	Present dietary habits and physical development	20 vegans, no comparison group	6-13 years	Prospective, 5-7-day weighed food record, anthropometric measurements	Low calcium intakes were noted. A carefully implemented vegan diet can result in normal child development, be careful of a bulky diet and vitamin B12 deficiency.
Krajcovicová-Kudlácková et al. 1997 (46) Slovakia	Examine fatty acid blood profile	7 vegans, 15 ovo-vegetarians, 10 pescovegetarians, 19 omnivore controls	11-15 years	Cross-sectional, blood sample, dietetic questionnaires	Beneficial fatty acid blood concentrations apart from significantly lower n-3-fatty acids.
Larsson et al. 2001 (47) Sweden, Norway	Determine prevalence of vegetarianism and investigate food habits	22 vegans, 128 vegetarians, 1891 omnivores	15,5 years (mean age)	Cross-sectional, questionnaire	Similar intakes of fruits and berries, alcoholic beverages, ice cream, sweets and chocolates, as the omnivores. It is uncertain if previously seen health benefits of a vegan diet will continue to apply.

Larsson and Johansson 2002 (38) Sweden	Assess dietary intake and nutritional status	30 vegans, 30 sex-, age-, and height matched omnivores	17,5 years (mean age)	Cross-sectional, diet-history interviews, double labelled water method, urine and blood sample	The dietary habits among vegans varied greatly. Riboflavin, vitamin B12, vitamin D, calcium, and selenium intakes below recommendations (calcium and selenium remained low even when including dietary supplements).
Ambroszkiewicz et al. 2003 (48) Poland	Assess serum osteocalcin and leptin	8 vegans, 13 lacto-ovo-vegetarians, 2 lactovegetarians, 26 omnivore controls	2-10 years	Cross-sectional, blood sample	Lower levels of serum osteocalcin and leptin recorded among the vegetarian and vegan groups compared to omnivores. Reported possible negative effects on bone health and bone formation.
Larsson and Johansson 2005 (49) Sweden	Identify dietary nutrient sources	30 vegans, 30 omnivore controls	17,5 years (mean age)	Cross-sectional, diet-history interviews	A higher vegetable, berries and fruit intake compared to omnivores. Greater importance of dietary supplementation of vitamin B12, vitamin D, calcium, and selenium than omnivores. Important to meet energy needs and avoid nutrient-poor foods.
Ambroszkiewicz et al. 2006 (50) Poland	Assess effect of vegetarian diets on serum concentrations of homocysteine, folate, vitamin B12, and total antioxidant status	5 vegans, 21 lacto-ovo-vegetarians, 1 lactovegetarian, 5 ovo-vegetarian	2-10 years	Cross-sectional, blood sample	Low vitamin B12 levels among the vegans which might be masked by the especially high folate intakes. Monitoring is necessary to detect possible deficiencies.
Weder et al. 2019 (11) Germany	Compare intake of energy, macronutrients, and fibre, and additional anthropometric measurements	139 vegans, 127 vegetarians, 164 omnivores	1–3 years	Cross-sectional, 3-day weighed food record, online questionnaire	Vegan diet in early childhood can provide the same amount of energy and macronutrients as an omnivore diet. Normal growth of the children, however, the importance of sufficient energy and nutrient intakes is underlined through a small percentage of vegan children classified as stunted.

2.3.1 Beneficial characteristics of a vegan diet

A plant-based diet does have positive effects on the intakes of certain nutrients. Studies have shown that adult vegans meet the dietary reference intakes for macronutrients, fibre, and many micronutrients (e.g. folate, vitamin C, vitamin A) more often than omnivore controls (11).

Saturated fat and cholesterol

Fat is an important source of energy in the diet of young children (21). A fat intake of 25-40 E% is recommended for over two year olds to make sure the diet is sufficiently energy dense (51). However, for young children the fat profile should be considered, as adequate essential fatty acid intake is required for optimal growth and cholesterol and SAFA intake should be kept low to reduce risk of negative health effects (2,21). The intake of cholesterol is a problem specific to non-vegans as a vegan diet contains little to no dietary cholesterol. Both Swedish and Slovakian vegan adolescents have shown to have a lower intake of SAFA and cholesterol compared to omnivores (38,46). Similar results were shown in a Polish study of vegetarian and vegan children (50).

The most recent data on the dietary intakes of the general population of Finnish children in day-care is from the Increased Health and Wellbeing in Preschools (DAGIS) research project (52). The data was gathered in 2015-2016 on 3- to 6-year-olds attending day-care. The results show that the fat intake of the Finnish children was around 32 E% which is within the range of official recommendations. However, the intake of SAFA exceeded the recommendations. The DAGIS study reported the cholesterol intake of children as 25 mg/MJ on average (53). Meat dishes and dairy products cover over 50 % of daily dietary intakes of SAFA (52). In the adult Finnish population meat and egg dishes account for over half of the dietary cholesterol intake (20).

Carbohydrates and fibre

A suggested higher fibre intake among vegans is a direct result of the fact that vegans tend to get more energy from carbohydrates than omnivores do. However, too high dietary fibre intakes are not recommended in early childhood as the calorie density decreases and the child might not be able to eat enough for adequate nutrient intake (11,54). Further, with more bulk in the dietary tract, adequate absorption of protein, fat, and minerals could be at risk.

A study in German 1-3 year olds showed no difference in total carbohydrate intake among vegan and omnivore children (11). In contrast, a Swedish study showed adolescent vegans to have higher intakes than omnivores (38). The same Swedish study also showed lower intakes of mono- and disaccharides compared to omnivores. The DAGIS study reports that Finnish children get 49 E% from carbohydrate and their fibre intake is 2,4 g/MJ (53). Both the carbohydrate and fibre intakes are within official reference values. Over 55 % of the dietary fibre intake comes from cereals and bakery products with another roughly 25 % from vegetables, vegetarian dishes, fruit, berries, and fruit and berry products combined. The study further states that the intake of added sugars is well within recommendations for the 3- to 6-year-olds. The three main sources are fruit and berry soups, yoghurt and Finnish cultured milk, and sugar-sweetened juice, responsible for around 40 % of the added sugar intake. To note is that the intake of sweets nearly double from ages 3-4 to ages 5-6.

Vitamin C

Vitamin C is not stored in the body but is continuously needed as an antioxidant both inside and outside cells (22). As vitamin C helps absorb iron it is therefore additionally beneficial to have larger intakes in a vegan diet. Higher intakes have been shown in adolescent Swedish and adult Danish vegans compared to omnivores (36,38). In contrast a Finnish study comparing omnivores and vegans concluded that the omnivores had a higher dietary vitamin C intake (19). The DAGIS study show that Finnish children aged 3-6 generally reach the recommended vitamin C intake (53). Over two thirds of the dietary intake was covered by vegetables, vegetable dishes, fruit, berries, and fruit and berry products (52).

Folate

Folate is a generic term for folic acid and molecules that have the same biological activity as folic acid (22). Folate is an essential nutrient for a child's normal development as it plays an important role in DNA synthesis and cell division. Deficiencies could negatively affect growth and muscle health as well as lead to neurological symptoms. Inadequate vitamin B12 intakes has been shown to negatively affect folate absorption. A Swedish study showed higher blood concentrations of folate among vegan adolescents than omnivore peers, confirming findings of studies done in the 80's (38). A Polish study showed the intakes of vegan children aged 2 to 10 even exceeded recommended dietary intakes (50). Folate intake as reported by the DAGIS

study is above the recommendations (53). Roughly a third of the folate intake is from meat, meat dishes, milk, and dairy products.

2.3.2 Critical nutrients and their sources

When excluding all animal products, there is a concern for the dietary intakes of certain nutrients. The sources for these nutrients are traditionally seen as animal-based (22). As previously mentioned, children have higher nutritional needs than adults and if these needs are not met the effects can be long lasting. A critical nutrient is one that is mainly animal-based in a Western diet and low intakes have been indicated among vegans. The list of critical nutrients may vary slightly between different literature sources, but the main nutrients tend to be protein, long chained n-3 fatty acids, vitamin D, vitamin B12, calcium, iron, iodine, and zinc (11,26,55). Some studies suggest that vitamin A also could be a nutrient of interest, so it is also included in the analysis of this thesis (36,38). Selenium would have been a nutrient of interest in this study however, due to unreliable data in the AivoDiet software, it will not be discussed further (53).

Energy

The growth spurt of the first few years of life and the higher resting metabolism makes the need for energy especially high in early childhood. It is also important for a growing child to have a continuous intake of energy. As vegan diets tend to be richer than omnivore diets in low energy density foods like fruits and vegetables it is important that high density foods are incorporated in the diet to ensure adequate nutrient density (9,21). A review study found vegan children to have lower energy intakes than the reference values (9). The DAGIS study show that on average Finnish children met their daily energy requirements (53). Roughly half of the energy intake of the 3- to 6-year-olds was covered by cereals, bakery products, milk, and dairy products (52).

Protein

A growing child needs amino acids to synthesize body proteins and produce hormones and neurotransmitters (9). Growing children need to get all ten essential amino acids from the diet and it is recommended that 40% of the protein intake be essential amino acids (56). Protein sources with a good biological value can be either so called complete protein sources, e.g. dairy

and eggs, or so-called complementary protein sources, e.g. a combination of wheat and legumes. If the caloric intakes are adequate, the intake of protein on a vegan diet has been according to, or even exceeding, recommendations in recent studies (6). Even so, a Finnish study noted that the energy intake from proteins among adult vegans is lower than that of omnivores (19). Due to differences between animal and plant-based protein composition and digestibility, the protein needs of vegan children could be slightly higher than their omnivore peers. In international articles it has been suggested to recommend that the intake of 1- to 2-year olds be 30-35% higher than omnivore peers, intake of 2- to 6-year olds be 20-30% higher and older than 6-year-olds be 15-20% higher (6). The DAGIS study reports that the protein intake of Finnish children aged 3-6 has been according to recommendations, roughly 16 E% (53). Around two thirds of the protein sources were animal based with the most prominent plant-based sources being cereals and bakery products covering roughly a fifth of protein intake (52).

Fat and n-3 fatty acids

As previously mentioned, an adequate intake of the essential fatty acids is crucial for a developing child. Even though the main sources for the essential fatty acids linoleic fatty acid (LA) and alpha-linolenic fatty acid (ALA) are plant-based (e.g. rapeseed- and soya bean oil) the dietary sources for their longer derivates are mainly found in animal products (e.g. meat and fatty fish) (57). In the human body LA is transformed into arachidonic acid while ALA serves as a predecessor to both eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). ALA and DHA are classified as conditionally essential during early development. They both play an important part in retinal and brain development (21). As ALA is the precursor to both EPA and DHA in the human body, higher intakes of this fatty acid could be recommendable for vegans (6).

The diet of vegetarians has been shown to be limited in these long-chained n-3 fatty acids (6). A Swedish study showed that young female vegans had a lower total fat intake and monounsaturated fat (MUFA) intake than omnivore peers (38). The vegan group as a whole also had a lower intake of polyunsaturated fat (PUFA). Vegan subjects have been shown to have lower blood and tissue levels of longer-chain PUFA than omnivore subjects (6,58). But whether a lower n-3 fatty acid level has health consequences is uncertain. It is not known if the levels measured in omnivore subjects are optimal or if they exceed the physiological requirements. Therefore, there is no consensus on if the conversion rate of n-3 fatty acids is

inadequate or simply that the body only produces as much as is needed (58,59). No negative effect on visual or mental development has been demonstrated in vegan children, indicating that there is sufficient intake of said fatty acids (60). The concentrations of DHA and EPA in the plasma of adults are similar among vegans and vegetarians independent of the duration of the diet in question, suggesting that even though levels are lower than that of omnivores they are stable (60,61). A low-fat diet (<25E%) in children has shown negative impacts on weight gain and height (57). In day-care aged children a low-fat diet (<30%) has been associated with too low intakes of fat-soluble vitamins (57). The DAGIS study show Finnish children aged 3-6 barely reached the recommended intakes of MUFA and PUFA, however, ALA intake was according to recommendations (53). Plant-based sources made up roughly 50 % and 60 % of MUFA and PUFA intakes respectively (52).

Vitamin A

Vitamin A is a group name for compounds with the biological activity of retinol. To report dietary intakes the unit retinol equivalent (RE) is used to include all dietary sources, such as the beta-carotene in vegetables. Vitamin A plays a key role in the function of the eyes and regulating gene functions (22). However, large dietary intakes of vitamin A is not recommended as it increases the breakdown of bone and prevents the formation of new bone. It has also been suggested that it could diminish the effects of vitamin D in the bones.

A low intake of vitamin A has been noted in vegan Danish adults, however, there is no research on the intake of children (36). In an adult Swedish study vitamin A intakes were below recommendations for a minor part of the vegan group (38). However, several studies show adequate vitamin A intake among vegan adults and children (19,38,62,63). Among them a Finnish study on dietary intakes among 1-year-olds (62). According to the DAGIS study Finnish children aged 3-6 reach the recommended intakes, however, intakes vary considerably (53). Fish, egg and meat dishes together with dairy products cover a third of the children's vitamin A intake with vegetable and potato dishes, fruit, and berries another third. Fats, oils and gravy cover roughly a fourth.

Vitamin B12

Vitamin B12 is essential for the development of foetuses and young children, a lack thereof can lead to permanent neurological development disorders (56). Long-term deficiencies in adults

might lead to serious health results (stroke, dementia, poor bone health) (6). Even though it is a water-soluble vitamin, enough vitamin B12 is stored in the body to cover the needs of an adult for years (22). However, it is important to have a continuous dietary or supplemented intake, as deficiency symptoms can go overlooked if the folate intake is continuously great (50). Vitamin B12 is essentially found only in animal products, e.g. fish and meat (64). A vegan diet contains no reliable source of vitamin B12 (6,55,65). For anyone on a vegan diet vitamin B12 should be included in the diet as supplements or from a fortified product, e.g. plant-based milk.

Deficiencies have been documented in the infants of breastfeeding vegan mothers as well as in older vegan children and vegan adults (9,50,64). A study done on Finnish adult vegans concluded that a lower intake of vitamin B12 was seen in the vegan group compared to the non-vegan controls (19). A similar study in Swedish adolescents showed a lower dietary intake of vitamin B12 than daily requirements. The blood concentrations were also lower than the omnivore's, however, still within the reference range suggesting adequate supplementation (38). The vitamin B12 requirements of Finnish children aged 3-6 are easily fulfilled according to the DAGIS study (53). Milk and dairy products alone cover over 50 % of the daily intake.

Vitamin D

As a regulator of the calcium and phosphate metabolism, vitamin D is an important nutrient in the mineralisation and reabsorption of bone (66). Deficiencies may lead to insufficient bone mineralisation and higher risk of osteoporosis later in life (21). Vitamin D exists in two forms ergocalciferol, vitamin D2, and cholecalciferol, vitamin D3 (67). Vitamin D3 has been shown to be more bioavailable than vitamin D2. Sources for vitamin D2 are plant-based while vitamin D3 can be synthesised in the skin and is also found in animal-based products. Interestingly, vitamin D3 supplements are now being made from lichen making them suitable for vegans (68). Fatty fish, egg and dairy are important vitamin D food sources, which means that vegans are at risk of low intakes if the diet is not well planned and supplemented (9). Since 2003, there has been an official recommendation in Finland to fortify milk and margarine with vitamin D, which over the years has improved the previously low vitamin D status of the population (69,70).

Vitamin D deficiencies have been reported among young children in several industrialised countries (21). A Polish study showed that vegetarian and vegan children had half the vitamin D intake as their omnivore peers (40). Furthermore, biochemical bone turnover markers were

significantly lower in the vegetarian and vegan children. Dietary intakes of vitamin D were insufficient in a group of young female Swedish vegans (38). A study done on Finnish adult vegans concluded that a lower intake of vitamin D was seen in the vegan group compared to the non-vegan controls (19). Vegans and vegetarians tend to have lower levels of 25-hydroxyvitamin D (25(OH)D) concentrations in the blood (40,41,71). However, there are studies that show no difference between vegetarian and omnivore subjects (72). In Finland the levels tended to be below recommendations especially when measured in the winter or springtime (73). The DAGIS study reports that the children do not reach the recommended 10 µg of vitamin D solely from the diet (53). Fish dishes, milk and dairy products together cover over half of the dietary vitamin D intake (52). Additionally, fats, oils and gravy are responsible for over a third.

Calcium

Calcium is an important part of cell communication reactions and a significant part of bone and teeth structure (2,21). In childhood when the body is going through growth spurts the body is able to absorb much more than the normal 20-45%, e.g. during the first years of life around 60% of dietary calcium is absorbed (56). Also, if the diet is low on calcium the body can make the absorption more effective, even though this does not mean that the needs of the body are met. The bioavailability of calcium from plant-based sources may be as low as 5% and it is therefore important to be educated on good dietary sources (6,39). If the diet includes a lot of phytate this could bind calcium and decrease the amount absorbed (21). A diet rich in animal protein has been connected to higher excretion of calcium in the urine, a burden not experienced by vegans. However, the calcium intake of vegans is varied and could be insufficient, therefore supplementation might be necessary (6,51). All nutrients involved in bone metabolism are important for children and calcium and vitamin D are two key nutrients for normal bone mass and prevention of osteoporosis (40). As a vegan diet excludes many of the traditional sources, it is important to make sure that dietary intakes are sufficient. Any deficiencies might affect the development of bone mass.

A Swedish study showed that adolescent vegans had an intake below recommendations even after supplementation (38). A Polish study with vegans aged 2-5 years had similar results, with calcium intakes being below recommended level, however, serum levels were within the physiological range (40). According to the DAGIS study, Finnish children reach the

recommended intakes of calcium (53). Over 75 % of the dietary calcium intake comes from milk and dairy products (52).

Iron

During the first years of life iron is crucial for cognitive and motor development in children as well as for normal immune function (21,74,75). Further, deficiencies in early childhood have been shown to have effects on social-emotional function later on in life (75). However, an overload of iron intake, e.g. through excess supplementation, can negatively impact growth and immune function in young children. This is why it is important to assess when supplementation is needed and when it is not. Iron metabolism is very controlled in the human body as there are no routes of excretion (75). Animal products contain heme iron, which is more easily absorbed than plant derived non-heme iron (75,76). The absorption of non-heme iron in young children can vary drastically depending on the iron stores of the individual as well as the composition of the meal consumed (75). The bioavailability can be improved through avoidance of inhibitors, e.g. phytate, and the presence of enhancers, e.g. vitamin C (77). Absorption can be 10 times greater in iron deficient subject, compared to subjects with adequate iron status (6). Vegans should aim for a 1,8 times higher iron intake than omnivores, as absorption is limited (8). So, even though vegans usually consume at least as much iron as omnivores, their iron stores may be lower than those of omnivores. However, Western vegetarian diets have been shown to yield a similar iron status as omnivores (6).

In a review study on vegetarian diets in children, iron deficiencies were found in half of the vegetarians (9). In contrast, higher iron intakes were seen among young female Swedish vegans than their omnivore counterparts, however, lower iron status was as prevalent among females in both groups though still within the reference range (38). An Australian study showed an equal distribution of low iron storage in both omnivore and vegetarian women (78). Among Australian men the iron intake was higher among vegetarians and vegan yet these groups had higher rates of low iron status as compared to omnivores (79). Even though deficiencies are rare in industrialized countries, supplementations might be recommended in certain cases (51). The DAGIS reports that the dietary iron intake among Finnish children aged 3-6 are below recommendations (53). Heme-iron sources such as fish, egg and meat dishes, and dairy products cover roughly 30 % of the dietary iron intake (52).

Iodine

Iodine is essential in thyroid hormone production (80). Thus, iodine is a key nutrient for brain development during the first years of life but is also later needed for normal growth and development (9,22,81). Deficiencies in children could lead to development and growth issues. Iodized salt and seaweed are main sources for iodine in vegans, however it is not recommended to rely on seaweed as levels may reach the upper tolerable limit (6,54). Supplementation is recommended for all vegans (51). In a Finnish study both adult vegans and omnivores had low intakes of iodine, which suggests that this is a nutrient of interest in Finland on a populational level (19). Dietary iodine intake among adult Danes has been shown to be below recommendations (36). Adult Swiss vegans were reported to have lower urinary iodine concentration than both vegetarians and omnivores, and clearly below the recommended values (65). Finnish children aged 3-6 years reach the recommended level of iodine intake from the diet according to the DAGIS study (53). The main dietary sources are milk and dairy products covering nearly half of the intake (52). Cereals and bakery product cover an additional fifth.

Zinc

The need for zinc is higher in childhood and therefore children are at risk for deficiencies (2,21). Even a mild deficiency may lead to symptoms if it is present over a longer period of time (2,82). Growth may be disturbed as well as brain and sexual development if needs are not met (2,21). An adequate storage of zinc is also important for a child's immunity (21,82). As zinc is critical for normal growth, infants and toddlers have a higher need and are at risk of deficiencies, especially if eating a mainly plant-based diet (82). The bioavailability of zinc can be improved to some extent through similar inhibitors and enhancers as iron (6,21,77). As it does for calcium, dietary phytate can decrease the absorption of zinc. In addition, it has also been shown that animal protein improves the absorption of zinc, which is why the Finnish Nutrition Recommendations state that the daily requirement of zinc for a vegan is 25-30 % higher than that of an omnivore (55,77).

Zinc deficiencies are most common in children who don't eat meat and have a high cereal fibre intake (21). More studies are needed on whether zinc levels are lower in vegan and vegetarian children as compared to omnivores (6,83). In adults, similar or slightly lower dietary zinc intake as well as serum zinc levels has been measured in vegans and vegetarians compared to omnivores (83). Lower dietary zinc intake was noted among young Swedish vegans compared

to omnivores, but for all but one individual they were within the recommended range (38). Generally, deficiencies are uncommon in industrialized countries, but supplementation might be necessary in certain cases (6,51). The DAGIS study reports that dietary zinc intake among Finnish 3-6 year olds is according to recommendations, however, on the lower end (53). Cereals and bakery products cover under a third of dietary zinc intake, similar to milk and dairy products (52). Fish, egg and meat dishes together cover a fourth of the intake.

2.3.4 Planning a vegan diet for a child

Children have different nutritional needs than adults and this should be taken into consideration when planning a vegan diet for a young child. Due to the rapid growth and a higher resting metabolic rate during the first five years of life, children have a higher need for energy, protein and other nutrients per kilo bodyweight than adults do (2,21). Because a young child is unable to eat large quantities of food, the diet needs to be energy and nutrient dense for the child to be able to consume enough nutrients to meet their needs (21). During the first years of life it is essential that all micronutrients are consumed in sufficient amounts to meet the needs of the fast growing body (21). The high need for vitamins and minerals is paired with a low storage of these in the first years of life, making dietary sources crucial for optimal growth and development. The specific needs of a growing child could be an additional challenge when planning a vegan diet.

The Finnish Nutritional Recommendations from 2014 state that to plan a vegan diet is more challenging than a vegetarian diet (55). The guide only recommends a vegetarian diet as suitable in all walks of life and does not take a stand on a vegan diet. However, in the 2016 recommendations for families with children a well-planned vegan diet is stated as suitable for pregnancy, breast-feeding and young children as long as the diet contains fortified food products and nutritional supplements (51).

In a typical Western diet, animal products are the main source for many nutrients. In a vegan diet these products are excluded, and other plant-based sources need to replace them to ensure adequate nutrient intake. If a vegan diet has been adopted for ethical or ecological reasons rather than health reasons, there could be a lack of nutritional knowledge or interest to plan a well-balanced diet (38). As in any population group, the nutritional knowledge of vegans may vary

substantially (19). Even so, there is more general knowledge today than a decade ago on how to compose a balanced vegetarian or vegan diet (19). Nonetheless, vegan families should be offered nutritional guidance from a dietitian at the latest when the child starts eating the same meals as the rest of the family (51). It is important to make sure that the parents or guardians have the required knowledge to plan a balanced vegan diet that meets the child's nutritional needs. The plate model is a practical tool to use when planning and putting together meals for a balanced diet (84). The vegan plate model differs slightly from the omnivore one to help in the planning of meals (Figure 1).

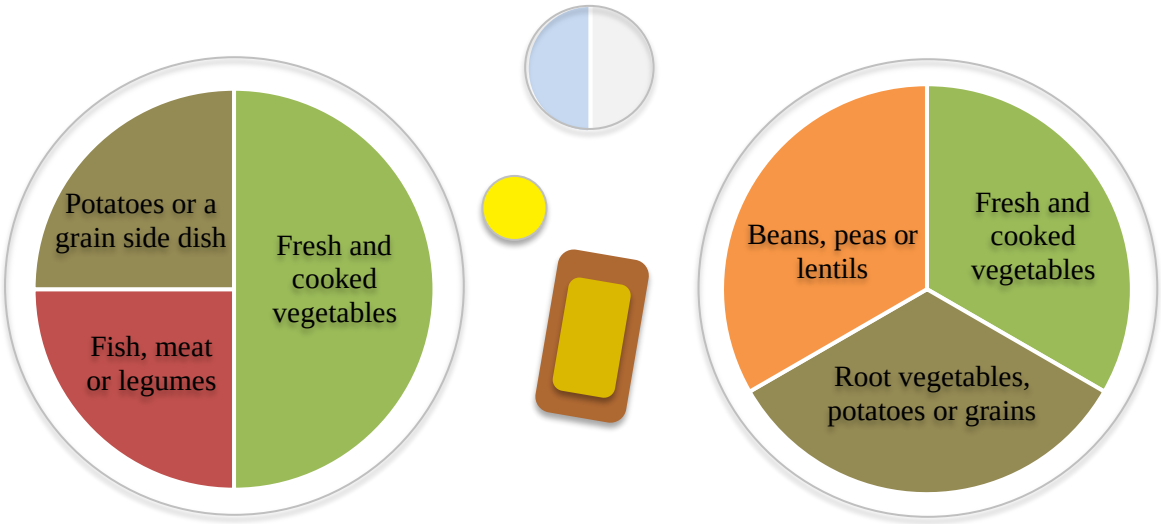

Figure 1. Omnivore (left) and vegan (right) plate model, including a drink (water, dairy or enriched plant-based drink), bread, margarine and oil-based salad dressing (84).

A vegan diet is based on legumes, grains, vegetables, fruit, berries, nuts and seeds. The general nutritional recommendation is for whole foods to be the base of the diet, and the vegan diet is no different. A few decades ago, there were not many other options for vegans because the selection of suitable convenience foods and treats was slim. In the last few years there has been a notable increase in vegetarian and vegan food options available in Finnish supermarkets (13,85,86). This includes more processed foods as well as more fortified foods (13). To incorporate some of these foods may substantially improve nutrient intakes for vegetarians and vegans. However, the salt content should be kept in mind for young children (6,51,77). There are plenty of properly fortified dairy milk substitutes in food stores today and these should be chosen over non-fortified options. It is recommended to look for milk substitutes without added sugars (51). However, rice drinks are not recommended in large quantities for children under

the age of six and not at all for children under one year of age because of their arsenic concentrations. There is no plant-based infant formula on the Finnish market so vegan infants under one year that are not breastfed are at nutritional risk. Therefore, a vegan diet is not recommended for infants.

It is important that varied sources of protein need to be included in the diet of vegan children (21). In comparison to animal protein that contain all essential amino, a single plant-based protein source needs to be combined with other plant-based protein sources to contain all essential amino acids. A complete protein profile can be achieved by combining e.g. legumes and cereals. For children it is especially important that these proteins should be combined in the same meal. To ensure that the diet contains enough essential fatty acids, rapeseed or canola oil should be the cooking oil of choice and margarines should have a fat content of at least 60 % (51). It is also important to note that seaweed should not be used in the diet of children under the age of six unless its iodine content is known.

Supplementation

In addition to a balanced and varied diet based on whole plant-based foods, supplementation is necessary to ensure adequate nutrition. The Finnish Nutrition Recommendations state that all children aged 2-17 years should supplement with 7,5 µg vitamin D throughout the year (55). Further, it is recommended that vegan children supplement their diet with at least vitamin B12 and iodine but also other key nutrients according to specific needs (51). There is more knowledge of and options for appropriate dietary supplementation compared to a decade ago. A higher use of supplements among Swedish vegan adolescents compared to omnivore peers shows that there is an awareness around this issue (38). Swedes following a stricter vegetarian diet also had a more frequent supplement use (47).

2.4 Mass catering at day-care

Most children under school age in Finland attend day-care. In 2017, 71 % of all 1-6-year olds in Finland attended day-care, however, there were significant differences in attendance depending on the child's age (see Figure 2) (87). Over three quarters (76%) of children are in day-care centres run by a municipality. As the day-care centres run by the municipalities are

the most common, this thesis will focus on the catering possibilities and regulations regarding this form of early childhood education and care.

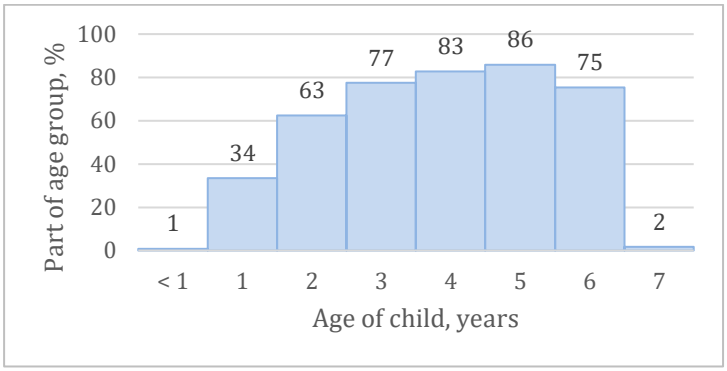

Figure 2. The amount (%) of children in day-care compared to population age group, all forms of day-care are included (87).

By law all children enrolled in day-care have the right to healthy and nutritious food that meet their requirements (88). The majority of children are enrolled full-time, which means they are on average served three meals a day at day-care, most commonly breakfast, a warm lunch, and an afternoon snack (84). The catering service may be provided by the municipality itself or outsourced to a catering company. In either case, the municipalities are legally bound to ensure that the served food meets set health requirements. This could include following official guidelines and recommendations as well as monitoring and evaluating the served food. However, the recommendation set by the National Nutrition Council are not legally binding and there is no national oversight of the food served at day-care centres in Finland (89).

2.4.1 Recommendations guiding mass catering

The ‘Health and Joy from Food – meal recommendations for early childhood education and care’ guidelines were published in 2018 by the Finnish National Nutrition Council and is the first publication aimed at mass catering in early childhood education and care (84). The recommendations are meant to support early education providers when organising catering for young children. This publication in turn is based on the Finnish Nutrition Recommendations from 2014 and ‘Eating Together – food recommendations for families with children’ from 2016 (51). The official recommendations for early childhood education and care should both guide

the municipality in choosing a catering company as well as provide practical guidelines for the caterer (Figure 3) (84). As previously stated, it is the responsibility of the municipality that the chosen catering company abides by the recommendations and regulations. A well-balanced diet following the nutritional recommendations is the goal.

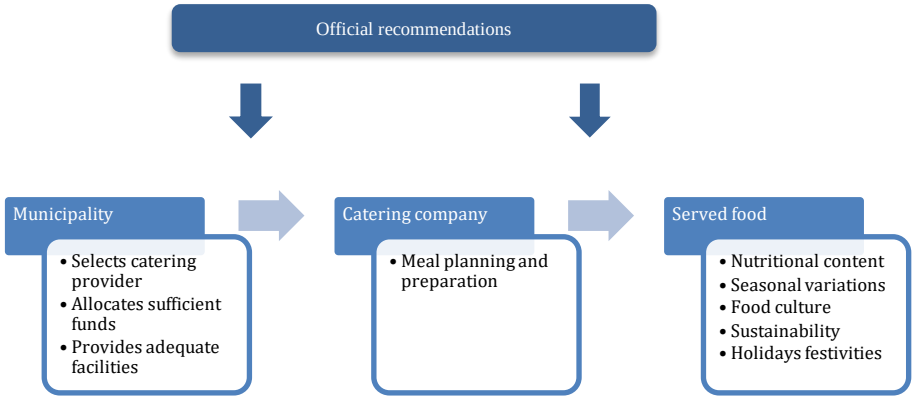

Figure 3. The influence of the official recommendations on mass catering at day-care.

The recommendations not only provide guidance on the nutritional content of the food, they also address other aspects of eating. The food is seen as another pedagogical tool to teach children about healthy eating habits and a varied diet. During the years in day-care, a child develops and learns to eat independently and in a communal setting. Children are encouraged to be part of preparing the food to help them get familiar with new food stuffs. Set mealtimes every three to four hours teach children about a regular meal schedule and to adapt their own eating thereafter. The environmental impact should also be considered in all stages of food preparation, from choosing local ingredients when possible to preparing the meal and portioning out the food to minimise food waste.

This form of regulated mass catering to such a large part of the young population is an opportunity to even out dietary nutritional differences between children from different socio-economic classes. Evidence has indicated that children in day-care outside the home has a diet more in line with national recommendations (5). A variety of different dishes are served at day-care so all children should be familiar with at least some while also being exposed to new foods. Vegetarian dishes are recommended at least once a week. By closely regulating the catering in day-care centres and communicating with parents and guardians about menus and plate models, it is hoped that the quality of the child's diet also improves at home. The food habits and nutrition lessons learned in early childhood education and care play an important part in the

future health and wellbeing of the children. Mass catering is therefore an important part of reaching health equality.

2.4.2 Nutrition recommendations at the day-care

The meals served at day-care should be planned so that they cover about two thirds of the daily energy and nutrient need of the children (84). However, only energy intake, proportions of macronutrients and salt intake are highlighted with specific recommendations (Table 3 and 4). Without specific recommendations it can be assumed that the dietary intake of micronutrients at day-care should provide roughly two thirds of the total daily recommendations. The recommendations have taken into consideration that the amount of food a child eats can vary from day to day. By stating that energy and nutrient recommendations should be met on a weekly basis, some flexibility is left for day-to-day variations in dietary intakes. For special holiday festivities and packed lunches, some nutritional requirements may be disregarded.

Table 3. Recommended daily energy intakes for children in full-time day-care, depending on age.

Age group	Energy, kcal (MJ) /day
6 to 12 months	550 (2,3)
12 to 23 months	640 (2,6)
2 to 5 years	800 (3,3)
6 to 9 years	1,100 (4,6)

Table 4. Nutritional recommendations at day-care for children in full-time care.

	E%	Specifics
Fat	30-40%	
SAFA	<10E%	Per meal
Carbohydrates	45-60E%	
Added sugar	<10E%	Natural sugars in milk, berries, fruit and vegetables do not need to be avoided
Protein	10-15E%	
Salt		Children aged under 2: <1,3g Children aged 2 to 5 years: 2-2,6g

The use of iodised salt at day-care centres is recommended and plant-based drinks fortified with iodine should be preferred (84). The margarine used should have a fat content of at least 60 %. Additionally, attention should be payed to the fat quality of animal products with fish being the healthiest option. Low-fat dairy products are should be chosen, and dairy milk should be fortified with vitamin D. Red meat, sausage and cold cuts should not to be served daily.

2.4.3 A vegan diet at day-care

To date, there have been no studies showing how being served a vegan diet at day-care might affect the dietary intakes of children. A parent or guardian can request a special diet for their child at day-care. However, if the request is not medically motivated, i.e. if it is based on religious or ethical beliefs, it is the decision of each municipality whether they will accommodate these special diets. Therefore, it depends on the municipality if the day-care centres are able to offer a vegan diet upon request. The municipality also considers economical and resource issues in their decision. Any meal diverging from the normal meal plan adds costs and food waste and takes up more of the employer's time. Special food products related to a special diet could be brought to the day-care kitchen by the parents or guardians. This mainly includes clinical nutrition products for disease treatment but could also be applied to animal-product substitutes in municipalities that do not provide vegan food upon request.

The official recommendations state that a well-planned vegan diet can provide a child with all their nutritional requirements. Attention is needed for planning an adequate intake of all critical nutrients. The diet should include nutritional supplements, fortified food products and a wide variety of plant-based protein sources (84). Dietary supplements are the responsibility of the home and will not be provided by the day-care. The aim is for all food at day-care to be as similar as possible regardless of special diet (84). No child should stand out more than necessary because of diet restrictions. In the case of a vegan diet, animal products should be exchanged for plant-based alternatives that complement the existing menu. Easy examples are dairy based drinks that are replaced with plant-based drinks or broiler soup replaced with vegetable-lentil soup. It is therefore necessary to develop additional vegan recipes for meal planning. The recipes need to contain enough energy and nutrients to meet the needs of growing children. For a practical example of how this adaptation may look see Table 5 for a weekly menu at a day-care centre in Helsinki that is serving vegan options.

Table 5. Weekly meal plan for omnivore and vegan meals at day-care centres in Helsinki taking part in the MIRA Helsinki study, provided by the municipality of Helsinki.

		Monday	Tuesday	Wednesday	Thursday	Friday
Breakfast	**Vegan**	Oat porridge, berries	Rye gruel made with soymilk bread, root vegetables wedges	Semolina porridge made with soymilk, fruit purée	Bread, hot chocolate with soymilk, vegetables wedges	Oat gruel made with soymilk, bread, fruit wedges
	Omnivore[1]	-	Rye gruel, cold cuts	Semolina porridge	Cheese, hot chocolate	Oat gruel, egg
Lunch	**Vegan**	Chickpea sauce, pasta, salad	Vegetable-lentil purée soup, bread, vegetable wedges	Vegetable-lentil casserole, salad, bread, soy yoghurt, berry purée	Black bean stew, mashed potatoes, salad	Falafel balls, potatoes, salad
	Omnivore[1]	Minced meat sauce	Broiler soup	Naturel yoghurt	Cheesy baked fish	Meatballs, brown sauce
Snack	**Vegan**	Bread, vegetables wedges	Fruit porridge	Bread, root vegetable wedges	Soy yoghurt, berry purée	Bread, vegetable wedges
	Omnivore[1]	Cheese	-	Hot dog with sausage	Baked pancakes with carrots	Cold cuts

1. Replacing or additional main meal and/or animal products

3. THE AIM OF THE STUDY AND THE RESEARCH QUESTIONS

The aim of this thesis was to evaluate the dietary quality of the vegan meals served at day-cares in Helsinki. This was done by presenting and comparing the dietary intake of children, aged 1-6 years, eating either a vegan or omnivore diet at day-care centres in Helsinki and taking part in the MIRA Helsinki study. Based on previous research, the following nutrients were chosen for analysis: energy, macronutrients, fibre, vitamin C, vitamin A, vitamin D, vitamin B12, folate, calcium, iodine, sodium, iron and zinc. If dietary intake of a nutrient differed significantly between the children eating vegan or omnivore meals at day-care, the main sources of said nutrient were described. Additionally, the nutritional contribution of day-care meals in the diet as a whole is presented.

The research questions were as follows:

1. Does the dietary intake of energy and nutrients at day-care differ between children eating vegan and omnivore meals?
2. What are the dietary sources for selected nutrients at day-care for the children eating either a vegan or omnivore diet?
3. How is the intake of nutrients divided between the day-care and outside of day-care?

4. PARTICIPANTS AND METHODS

4.1 The MIRA Helsinki study

In October of 2016, the city of Helsinki started a one-year experiment in 20 day-care centres, giving families the option to choose a vegan diet for their children. This was motivated by a desire to understand the cost of such an option in the future and if vegan food could be served without compromising on the nutritional adequacy of the diet. During the one-year testing period, researchers at the University of Helsinki conducted the MIRA Helsinki study. The project was a collaboration between the Department of Food and Nutrition and the faculty of Medicine, with contribution from the municipality of Helsinki. The study was designed to investigate the effects of a vegan diet on the nutrition status of children at day-care. The data for this thesis is derived from the MIRA Helsinki data.

At the time of recruitment, according to information given by the city of Helsinki, a vegan diet had been requested for 31 children at nine day-care centres. Researchers visited the nine day-care centres with invitation letters to be distributed to all parents requesting a vegan diet for their child, or children, at day-care. The parents of 25 children (80% of invited) returned a signed informed consent form. Researchers then distributed invitation letters to families with omnivore children of similar ages to the previously recruited children eating a vegan diet at day-care. The aim was to invite five omnivore children without any special diet at day-care for each child following a vegan diet at day-care. In total 161 families of omnivore children received an invitation letter, of which the parents of 34 children (21% of invited) returned the signed informed consent form. The total amount of participants was 59, aged between one and seven years old.

4.2 Study methods

4.2.1 Background information

Researchers used two online questionnaires to gather background information of the participants. A parent filled in a 45-question questionnaire concerning the child and a 20-question questionnaire concerning both parents. Reminders were sent out to any families who had not filled in the questionnaires after having sent in the food diary. From the online questionnaires the information used in this thesis was the child's current diet both at day-care and outside day-care. Also included is the children's sex and age, already provided by the parents in the consent form.

The MIRA Helsinki study methodology included a number of additional assessments that were not relevant for this thesis. Two separate online food frequency questionnaires (FFQ) were filled in, to assess dietary and supplement intakes for both the children and the parents. Researchers visited the day-care centres to take the following anthropometric measurements of the children; height, weight, upper arm length and mid-upper arm circumference measurement. The children also gave fasting blood samples and a single urine sample.

4.2.2 Assessing the dietary intake

Food diaries

The dietary intake of the children was assessed with a four-day food diary, covering at least one day off from day-care. The parents and the early educators were provided with separate food diaries to record consumed foods and beverages during weekdays (Attachments 1 and 2). They were also provided with the Children's Food Picture Book (90). This picture book assists with estimating the children's food portion sizes and therefore minimize the error of wrongly estimated food portions (91). It has previously been validated and proven a useful aid for the estimation of children's food portion sizes by both parents and early educators (92).

Researchers coordinated the record keeping period with the families and the day-care so that the food diary would be kept on the same days both at home and at day-care. In case the decided

days needed to be changed or the child fell so ill that it affected their appetite, parents were asked to contact the researchers to set-up new dates. After the recording period, the families sent the filled in food diary and the food picture book back to the research team in a provided envelope.

Instructions for filling in food diary

Anyone filling in a food diary needs to be properly informed on how to describe the foods and beverages with enough detail and how to accurately estimate portion sizes (91). The food diaries included written instructions and a sample of a filled in food diary to use as a model. All consumed foods and beverages and any ingested dietary supplements were to be included in the food diary. The families were informed to include the name, producer and fat contents of certain recorded foods and beverages, e.g. dairy products, meats and fat spreads. Further, they were asked to specify time and place of the meals and the recipe for any cooked meal. The early educators were not required to fill in the diaries to such detail, as the researchers had requested nutritional information on the food products served at the day-care (e.g. fat content of dairy or margarine) as well as all the recipes used during the study period from the catering company responsible for the city of Helsinki's day-care centres. To facilitate the filling in of the food diaries further, catering personnel at each day-care also filled in a short questionnaire on the use of salt and availability of certain products, e.g. dairy free yoghurt and milk options, at that specific day-care.

When estimating portion sizes measurements such as decilitre, gram, tablespoon, centimetre or pieces were suggested. The parents and the early educators were also encouraged to use the Children's Food Picture Book as guidance and write down the code for specific portion sizes in the food diary. It was suggested to fill in the food diary directly after every meal and to verify at the end of the day that all meals had indeed been recorded. Researchers reminded the families that keeping a food diary should not affect the child's eating behaviour, also mentioning that birthday parties and other celebrations are part of normal life and all foods and beverages consumed should be recorded as normal.

Nutrient calculations

Two members of the Department of Food and Nutrition research team, one research assistant and one student entered the data from the food diaries into the software program AivoDiet

(version 2.2.0.1). This nutrient calculation software included the Fineli Food Composition database Release 16 (2013), developed and updated by the Finnish National Institute for Health and Welfare (93). If the researchers noticed any missing products, their nutrient content was added to the software based on the nutritional information provided by the producer. It was especially vegan products that were added. Further, the nutrient content of widely used fortified products was updated, e.g. vitamin D content. To aid the researchers with data entry of foods consumed at day-care the requested information from the catering personnel at the day-cares and the catering company were used. To standardize the data entry, coding procedures were put in place. These aimed to minimize the variations between individuals handling the data entry.

In preparation for the analysis of the dietary sources the recorded foods and beverages were divided into 12 main categories and 97 subcategories following a similar division as a previously done study in Finnish day-care centres (52). As only a few of the subcategories were of particular interest most of them were not used in this thesis, and some existing ones were combined for the analysis. The ones of interest contained e.g. vegetarian dishes or plant-based products like plant-based milks or cooking creams.

The following nutrients were included in the data for this thesis: energy, macronutrients, fibre, vitamin C, vitamin A, vitamin D, vitamin B12, folate, calcium, iodine, sodium, iron and zinc. As previously stated, studies have indicated differences in the intakes of these nutrients in vegan subjects, as compared to omnivores. The sodium intake was calculated into salt (NaCl) by multiplying it by 2,548 (94). The average intake of macro- and micronutrients was calculated for each child and used in all further statistical analysis (95). The intake at day-care, at home and in total were calculated separately. The intakes at day-care were also calculated as a percentage of the daily intake by adding up the total intake of all participants and comparing that to the combined total daily intake.

Evaluating the raw data

Before any statistical analysis the raw data from AivoDiet was processed and checked for completeness by a researcher. Any missing nutrient values in new products were added and the created recipes were checked. For each macro- and micronutrient, the five outliers on both ends of the intake division were evaluated for data entry errors or food composition database errors (95).

4.3 Inclusion criteria for this thesis

The data of this thesis is a selected part of the MIRA Helsinki study. The study gathered data on 59 children in total, of which 25 ate vegan meals at day-care. However, out of these 25 children only nine were so called true vegans i.e. children eating a vegan diet both at day-care and at home. The rest of the children either ate some form of vegetarian diet or an omnivore diet at home. As there were such a small number of true vegans, the children eating vegan meals at day-care and some form of vegetarian diet at home were eligible to be included. The focus of this thesis remains the meals served at day-care, however, the omnivore children eating vegan meals at day-care were excluded as their data would have interfered with the analysis of total daily intake. Of the food records, only weekdays when the child attended day-care were accepted. Further inclusion criteria were that all three main meals at day-care (breakfast, lunch and snack) had to be recorded, in addition to all the food eaten at home during the same day. The aim was to evaluate the dietary intake and sources of nutrients and therefore any dietary supplements were not included.

Out of the total 59 children, 25 (42%) met all the inclusion criteria for this thesis. Of the 25, nine ate vegan meals at day-care (of which six were true vegans) and the other 16 were omnivores. As not all children eating vegan meals at day-care were vegan this group will be called the vegan meals group. The other group consists solely of omnivores and will be galled the omnivore group.

4.4 Statistical analysis

The statistical program SPSS (IBM Inc, Chicago, IL, USA) version 25 was used for all statistical analysis. As the study sample is small, the data was presented through calculating both the mean and standard deviation as well as the median and minimum/maximum intakes. The distribution of the continuing variable was examined with the Kolmogorov-Smirnov test. To analyse differences between the vegan meals and omnivore group the Mann-Whitney U test was used, as the variables were not normally distributed, and the sample size was small (96). The level of significance was set at $p<0,05$ (97). The dietary sources of certain nutrients were described according to the specified food categories and using mean values and percentage of total daily intake.

4.5 Ethics

The MIRA Helsinki study received ethical approval in May of 2017 from the ethical committee in the Helsinki and Uusimaa hospital district. Participation in the study was voluntary and all families gave their written consent to take part in the study. The researchers provided the families with information about the study process and gave all participants the possibility to ask questions or voice any concerns. Researchers also informed the participants of their right to leave the study at any time, without any consequences. All data collected was stored at the University, in locked rooms or password protected files, complying with data protection laws. Only the researchers of the MIRA Helsinki study were allowed access to the files. Any identification data was stored separately from the study data and any results were presented on a general level so that no individual could be identified. All families received the results of the blood analysis and were offered a summary of the child's nutrition status. Any required actions were communicated.

4.6 Own role in the study process

After having expressed interest in the MIRA Helsinki study, I started working with this thesis in the spring of 2017. During the summer and fall of 2017, I entered the food records into AivoDiet together with a research assistant. I developed new recipes and added new products to the database when needed. I was also involved in checking the raw data, specifically looking for outliers through checking the maximum and minimum intakes of certain nutrients. I did the statistical analyses in the spring of 2018 after which the writing process truly started.

5. RESULTS

5.1 Study subjects

The diets of the children in both the MIRA study and the selected sample included in the analysis for this thesis are described in Table 6. After the exclusion of cases that did not meet the criteria for this thesis, the analyses included a total of 25 children comprising 42% of the total study sample. Nine children ate vegan meals at day-care (36%), six of them being true vegans. Of the remaining three, two ate a lactovegetarian diet and one a pescatarian diet at home. However, for the analysis of this thesis they were included in the vegan meals at day-care group. There were three (33%) girls and six boys in the vegan meals at day-care group, and nine (56%) girls and seven boys in the omnivore group. In each group the children were between one and six years of age with a mean age of 3,2. As the groups were small to begin with, the children were not further divided according to age or sex. From the vegan meals at day-care group a total number of 21 days were accepted into the data, and 36 days from the omnivore group. Food diaries for three days were included for almost half (48%) of the children.

Table 6. The children's diet outside day-care, and which meals they were served at day-care. Both the original MIRA Helsinki data and the selected data for this thesis is presented.

		Vegan	**Lacto-ovo- and lacto-vegetarian**	**Pescatarian**	**Omnivore**	**total**
Original data	Diet outside of the day-care	8	5	7	37	57[1]
	Meals at day-care	25	-	-	34	59
Selected data	Diet outside the day-care	6	2	1	16	25
	Meals at day-care	9	-	-	16	25

1. Data on diet outside the day-care was missing for two children eating vegan meals at day-care.

5.2 Total dietary intake

In order to be able to put the intakes at day-care in proportion with the diet as a whole, the total dietary intakes of both groups will be presented below. Following this chapter, the importance of dietary intakes at day-care will be presented. The total macronutrient intakes of both the children eating vegan meals at day-care and the omnivore children are presented below (Table 7). There were significant differences in most macronutrient intakes between the vegan meals and omnivore group. However, the average daily macronutrient intakes complied to recommendations for the most part in both groups (55). Considering that the mean age of the children was 3,2 years the energy intakes were on average sufficient. Among the omnivore children, the SAFA intake was above recommendations and the PUFA intake too low. The average daily micronutrient intakes in both groups can be viewed in Table 8. The intakes generally exceeded the recommendation for children aged 2-5 years, except for vitamin D intake which was lower, and salt intake which was higher than recommended in both groups, as well as a too low iron intake among the omnivore children (55).

Table 7. Average total daily dietary energy and macronutrient intake among the vegan meals and omnivore group, with official recommendations as reference.

	Intake per day[1]		**Difference**[2]	**Recommendations**[3]	
	Vegan meals (n=9)	**Omnivore** (n=16)			**Specifications**
Energy, MJ	5,8 (0,6)	5,2 (1,0)	ns	2-5 years: 5,0 MJ 6-9 years: 6,9 MJ	
Protein, E%	13 (1,8)	18 (2,8)	**	10-20	
Carbohydrates, E%	50 (5,0)	48 (4,0)	ns	45-60	
Sucrose, E%	8,1 (2,9)	8,7 (4,1)	ns	<10	
Fibre, g/MJ	5,2 (0,8)	3,0 (1,0)	**	>2-3	
Fat, E%	33 (4,2)	31 (5,3)	ns	25-40	
SAFA, E%	6,4 (2,3)	12 (3,3)	**	<10	
Cholesterol, mg/MJ	1,6 (3,6)	25 (12,2)	**		
MUFA, E%	12 (1,9)	10 (2,0)	*	10-20	>2/3 of total fatty acid intake
PUFA, E%	10 (2,1)	4,8 (1,3)	**	5-10	
LA, E%	7,6 (1,4)	3,3 (1,2)	**	>3 of which 0,5 ALA	
ALA, E%	2,3 (0,5)	1,0 (0,3)	**		
EPA, mg/MJ	3,1 (9,3)	10,7 (12,5)	<0,001		
DHA, mg/MJ	9,2 (27,6)	33,4 (36,8)	<0,001		

1. Mean (SD)
2. Statistically significant difference (*= p<0,05; **= p<0,01; ns= non-significant (p>0,05))
3. Finnish National Nutrition Recommendations

Table 8. Average daily dietary micronutrient intake among the vegan meals and omnivore group, with official recommendations as reference.

	Intake/day[1]		Difference[2]	Recommendations[3]		
	Vegan meals (n=9)	**Omnivore** (n=16)		**12-23 mo**	**2-5 y**	**6-9 y**
Vitamin C, mg	60 (18)	79 (36)	ns	25	30	40
Vitamin A, µg RE	485 (104)	524 (190)	ns	300	350	400
Vitamin D, µg	8,8 (2,0)	9,4 (2,9)	ns		10	
Vitamin B12, µg	3,5 (1,8)	4,3 (1,6)	ns	0,6	0,8	1,3
Folate, µg	357 (93)	162 (40)	**	60	80	130
Calcium, mg	854 (210)	1072 (232)	**	600	600	700
Iodine, µg	100 (29)	185 (45)	**	70	90	120
Salt, g	4,6 (1,1)	4,5 (1,3)	ns		< 3-4	
Iron, mg	12 (1,4)	7,6 (2,0)	**	8	8	9
Zinc, mg	8,7 (1,8)	8,7 (1,8)	ns	5		7

1. Mean (SD)
2. Statistically significant difference (**= p<0,001; ns= non-significant (p>0,05)
3. Finnish National Nutrition Recommendations

Division of nutrients at day-care and outside day-care

The intakes at day-care compared to the diet as a whole is presented in Figure 4 and Figure 5. The proportion of intake at day-care and outside day-care does not speak of the amount of absolute intake for each nutrient. The day-care food contributed to 34% of the total intake of cholesterol in the vegan meals group and 37% in the omnivore groups. A bigger proportion of the SAFA intake of vegans was at day-care than for omnivores (vegan 48%, and omnivore 38% of total intake). For both groups the majority of the daily intakes of PUFA, LA and ALA were at day-care. Further, the omnivore children got 60% of the daily EPA at the day-care.

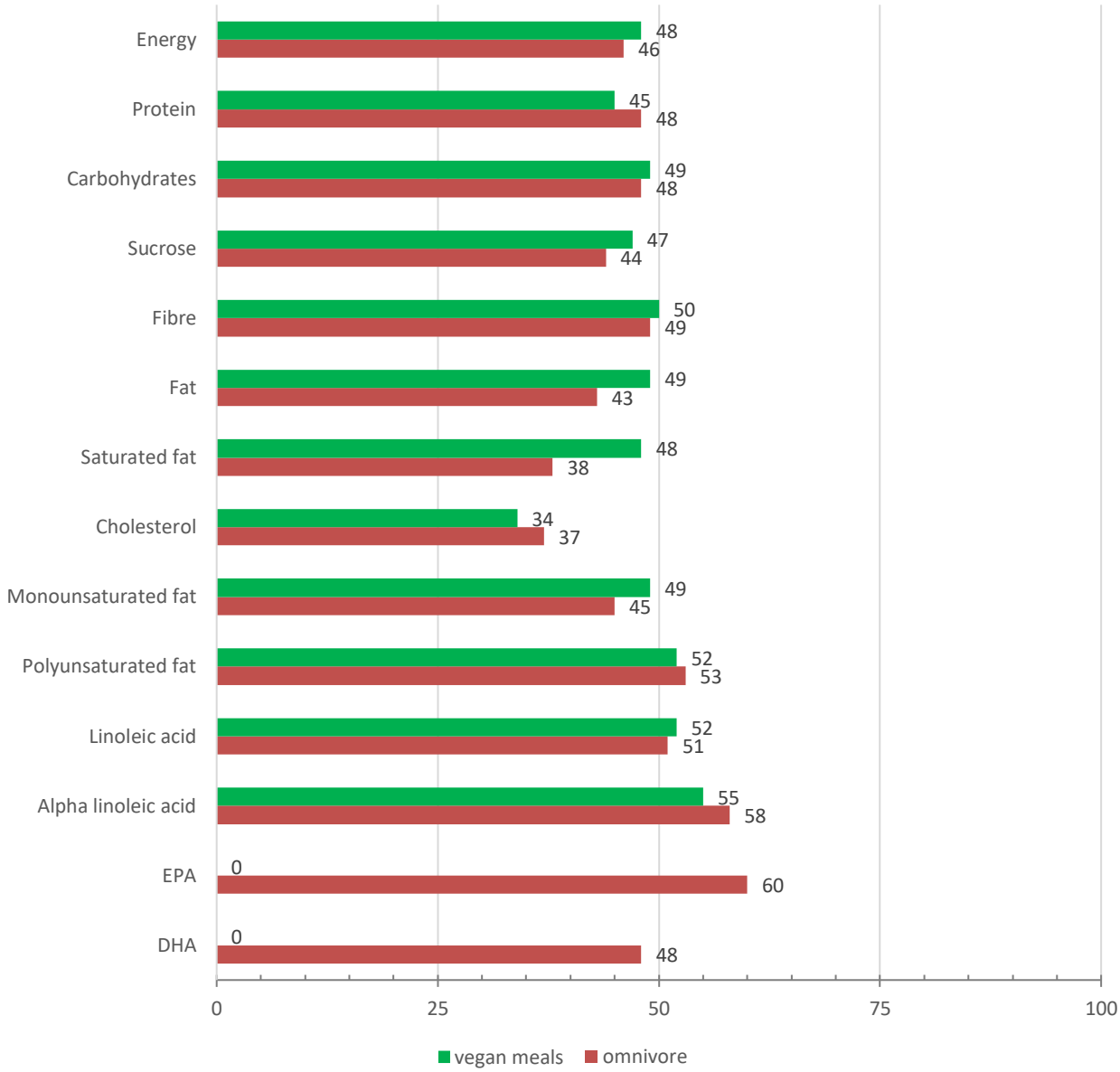

Figure 4. The dietary energy and macronutrient intake of the vegan meals and omnivore group at day-care, percent (%) of the total daily intake.

The day-care covered the majority of vitamin D, iodine and salt intake in both groups (Figure 5). The vegan meals group also got over 60% of their vitamin A intake at the day-care. Meanwhile, the day-care meals contributed only 38% and 32 % of vitamin C intake in the vegan meals group and omnivore group respectively.

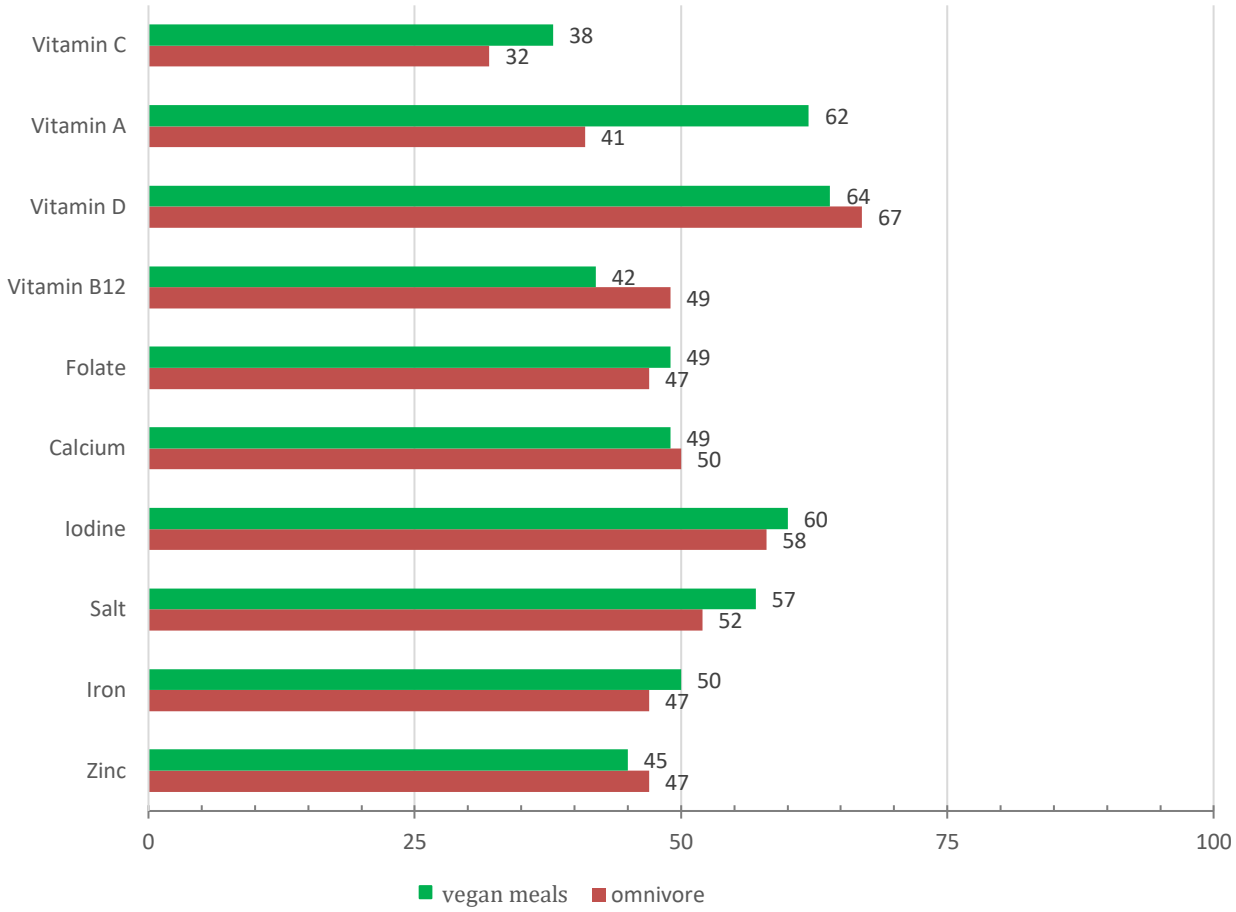

Figure 5. The dietary micronutrient intake of vegan meals and omnivore group at day-care, percent (%) of the total daily intake.

5.3 Dietary intake at day-care

Average dietary intake at day-care

Although the energy intake at day-care between the vegan meals and omnivore group did not differ there were significant differences in macronutrient intakes between the groups (Table 9). The omnivore children had a significantly higher protein intake as a percentage of energy ($p<0,001$), whereas the children eating vegan meals had a significantly higher fat intake as a percentage of energy ($p=0,008$) as well as significantly higher fibre density (g/MJ) ($p<0,001$). Further, the fat profile of the two groups were significantly different. No dietary intake of EPA and DHA was found among the children eating vegan meals.

Table 9. Average daily dietary energy and macronutrient intake at day-care among the vegan meals and omnivore group. Comparison done with the Mann–Whitney U test.

	Intake/day[1]		Difference, p-value[2]
	Vegan meals	**Omnivore**	
Energy, MJ	2,8 (0,6)	2,4 (0,9)	
kcal	658 (133)	584 (204)	ns
Protein, g	20 (5,0)	27 (9,9)	
E%	12 (2,7)	19 (3,3)	<0,001
Carbohydrates, g	82 (20)	71 (23)	
E%	50 (6)	50 (5)	ns
Sucrose, g	12 (4,2)	10 (5,6)	
E%	7,2 (2,2)	7,6 (3,8)	ns
Fibre, g	15 (3,6)	7,8 (3,1)	
g/MJ	5,3 (0,7)	3,2 (0,6)	<0,001
Fat, g	25 (5,6)	19 (8,7)	
E%	34 (3,5)	28 (6,3)	0,008
SAFA, g	4,5 (1,0)	6,0 (2,8)	
E%	6,0 (0,7)	9,0 (2,7)	0,007
Cholesterol, mg	0,5 (0,2)	41 (17)	
mg/MJ	0,2 (0,09)	18 (5,7)	<0,001
MUFA, g	9,5 (2,6)	6,8 (3,5)	
E%	13 (1,5)	9,9 (2,7)	0,007
PUFA g	8,2 (2,0)	3,8 (1,9)	
E%	11 (1,8)	5,4 (1,4)	<0,001
LA, g	6,0 (1,3)	2,5 (1,3)	
E%	8,2 (1,1)	3,6 (1,2)	<0,001
ALA, g	2,0 (0,6)	0,8 (0,5)	
E%	2,6 (0,4)	1,2 (0,4)	<0,001
EPA, mg	0	34 (53)	
mg/MJ	0	14 (20)	<0,001
DHA, mg	0	99 (158)	
mg/MJ	0	41 (58)	<0,001

1. Mean (SD)
2. ns= non-significant (p>0,05)

There were differences in micronutrient intakes per megajoule between the vegan meals and omnivore group (Table 10). The vegan meals group had significantly higher folate and iron intakes compared to the omnivore group (p<0,01). The average intake of iron in the vegan

meals group was 6.1 mg/day, the equivalent value in the omnivore group was 3.5 mg/day. However, the intakes of vitamin D, vitamin B12, calcium, iodine and zinc were significantly lower among the children eating vegan meals than the omnivores.

Table 10. Average daily dietary micronutrient intake at day-care among the vegan meals and omnivore group. Comparison done with the Mann–Whitney U test.

	Intake/day[1]		Difference[2]
	Vegan meals	**Omnivore**	
Vitamin C, mg	21,3 (7,4)	21,6 (8,2)	
mg/MJ	8,1 (3,3)	9,0 (2,3)	ns
Vitamin A, µg RE	293 (83)	204 (92)	
µg/MJ	109 (32)	85 (28)	ns
Vitamin D, µg	5,7 (1,7)	6,3 (2,6)	
µg /MJ	2,0 (0,4)	2,6 (0,6)	0,049
Vitamin B12, µg	1,6 (0,9)	2,0 (0,7)	
µg /MJ	0,6 (0,3)	0,9 (0,2)	0,043
Folate, µg	168 (46)	77 (31)	
µg /MJ	61 (16)	31 (5)	<0,001
Calcium, mg	429 (170)	536 (178)	
mg/MJ	156 (61)	230 (61)	0,010
Iodine, µg	61 (25)	109 (43)	
µg /MJ	22 (6)	45 (8)	<0,001
Salt, g	2,6 (1,0)	2,4 (1,0)	
g/MJ	0,9 (0,3)	1,0 (0,2)	ns
Iron, mg	6,1 (1,5)	3,5 (1,4)	
mg/MJ	2,2 (0,2)	1,4 (0,2)	<0,001
Zinc, mg	3,6 (1,0)	4,1 (1,4)	
mg/MJ	1,3 (0,2)	1,7 (0,3)	0,001

1. Mean (SD)
2. ns= non-significant (p>0,05)

As the study group was small, it is of interest to also view the median intakes as well as the minimum and maximum intakes. The values for both at day-care and outside day-care intakes are found in Attachment 3. For example, the SAFA intake at day-care among the omnivores varied greatly. In energy percent, the median SAFA intake for omnivores was 9,6 E% with

minimum intake of 4,4 E% and maximum 15,5 E%. For the children eating vegan meals, the median intake was 6,0 E% with a range from 5,3 E% to 7,5 E%.

Intake related to official guidelines

The average dietary intakes at day-care are presented together with the official recommendations in Table 11. In both groups the energy intake was lower than suggested, keeping in mind that the mean age of the children was 3,2 years. Among the children eating vegan meals, all further macronutrient intake complied with recommendations. The omnivore children had a higher energy percent intake from protein and a lower energy percent intake from fat than the recommendations. The recommendations further state that the SAFA intake should be less than one third of total fat intake (84). The SAFA intake made up 18% and 32% of total fat intake in the vegan meals and omnivore group respectively.

Table 11. Mean dietary intakes at day-care among the vegan meals and omnivore group with official recommendations as reference (84).

	Intake/day[1]		
	Vegan meals	**Omnivore**	**Recommendations(84)**
Energy, kcal	658 (133)	584 (204)	Under 2 years: 640 2-5 years: 800 Over 5 years: 1100
Protein, E%	12,4 (2,7)	19,0 (3,3)	10-15
Carbohydrates, E%	50 (6)	50 (5)	45-60
Sucrose, E%	7,2 (2,2)	7,6 (3,8)	<10
Fat, E%	34 (4)	28 (6)	30-40
SAFA, E%	6,0 (0,7)	9,0 (2,7)	<10
Salt, g	2,6 (1,0)	2,4 (1,0)	Under 2 years: <0,7 2-5 years: 2-2,6

1. Mean (SD)

5.4 Dietary nutrient sources at day-care

The daily food intake of the children was divided according to the food categories previously detailed in chapter four. To get an overview of the intakes of each category, Figure 6 and Figure 7 show the intakes both at day-care and outside day-care. At day-care the intake of fruits was much lower than outside the day-care. Cereals and dairy milk or plant-based milks are the main categories at day-care, together covering over 60% of the total food intake in both groups. Outside day-care these two categories cover less than half in both groups. The volume of each category in grams is presented in Table 12. Fruit intake at day care was 30g and 40g in the vegan meals and omnivore group respectively while at home the fruit intake was 135g in both groups.

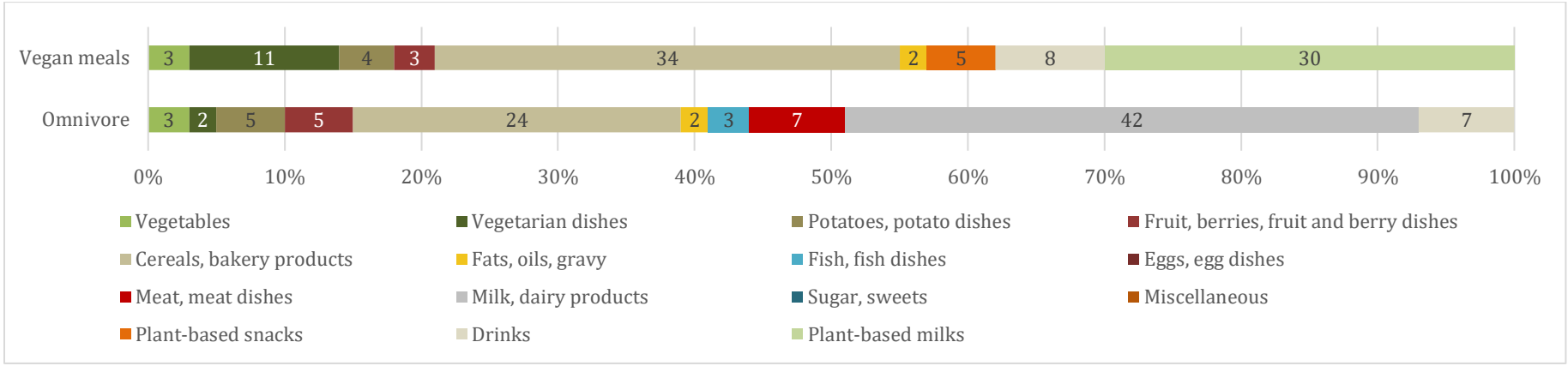

Figure 6. Consumption of food groups at day-care for the vegan meals and omnivore group, percent (%) of total consumption at day-care.

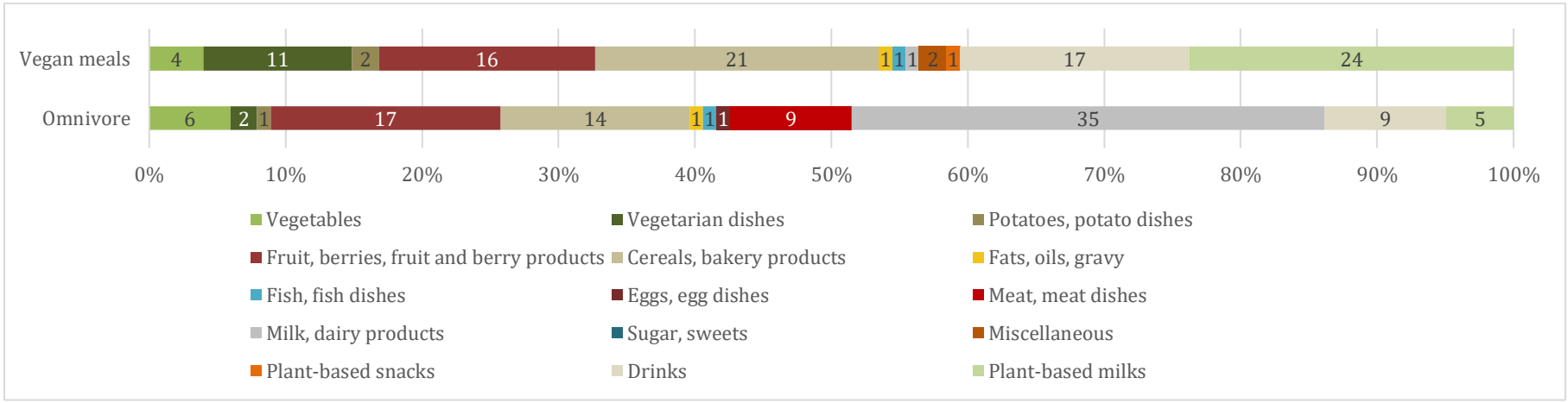

Figure 7. Consumption of food groups outside day-care for the vegan meals and omnivore group, percent (%) of total consumption outside day-care.

Table 12. Total daily consumption of food categories (g) of both the children eating vegan meals at day-care and the omnivore children.

	Vegan meals			Omnivore		
	At day-care	**Outside day-care**	**total**	**At day-care**	**Outside day-care**	**total**
	g/day	**g/day**	**g/day**	**g/day**	**g/day**	**g/day**
Vegetables	130	130	260	42	67	109
Vegetarian dishes	100	99	199	17	18	35
Potatoes, potato dishes	33	14	47	42	8	50
Fruit, berries, fruit and berry products	30	135	165	40	135	175
Cereals, bakery products	301	185	486	193	108	301
Fats, oils, gravy	15	7	22	14	5	20
Fish, fish dishes	0	10	10	27	9	36
Eggs, egg dishes	0	0	0	1	8	9
Meat, meat dishes	0	0	0	55	68	123
Milk, dairy products	2	6	8	334	276	611
Sugar, sweets	0	0	1	0	1	1
Miscellaneous	44	23	67	0	3	3
Plant-based snacks	43	12	54	0	0	0
Drinks	338	355	693	54	108	162
Plant-based milk	270	206	476	0	44	44
Tot. weight per day	**894**	**866**	**1760**	**805**	**796**	**1601**

5.5 Dietary sources of nutrients

Based on earlier analyses, only energy and the nutrients that significantly differed between the vegan meals and omnivore group are further described in this chapter. These nutrients are protein, fibre, fat, vitamin D, vitamin B12, folate, calcium, iodine, iron and zinc. The fat profile has not been separately detailed, but rather kept as one variable for simplicity. In this chapter the importance of each food category as a source for intakes of energy and the specific nutrients listed above are described as the percentage of nutrient intake that is associated with the categories. For a summary of the absolute intake of nutrients per food category at day-care see Attachment 4.

Energy sources

Cereals were the main energy source at day-care in both groups, followed by vegetarian dishes and plant-based milks in the vegan meals group and meat and dairy milk in the omnivore group (Figure 8). To be able to compare the diet at day-care and outside day-care the sources of energy outside the day-care have been described in Figure 9.

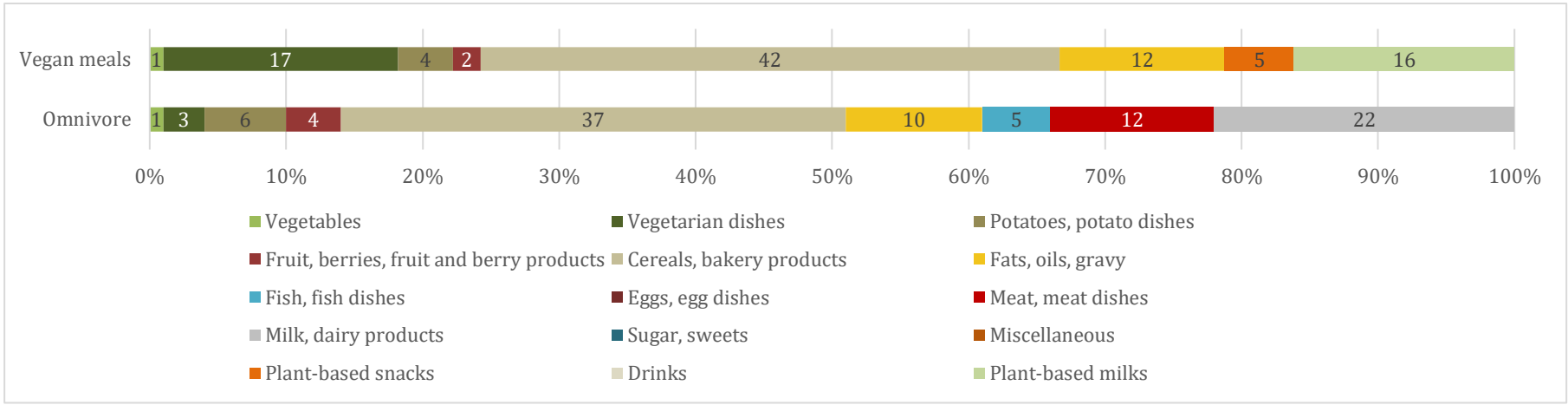

Figure 8. Energy sources among the vegan meals and omnivore group at day-care, percent (%) of total consumption at day-care.

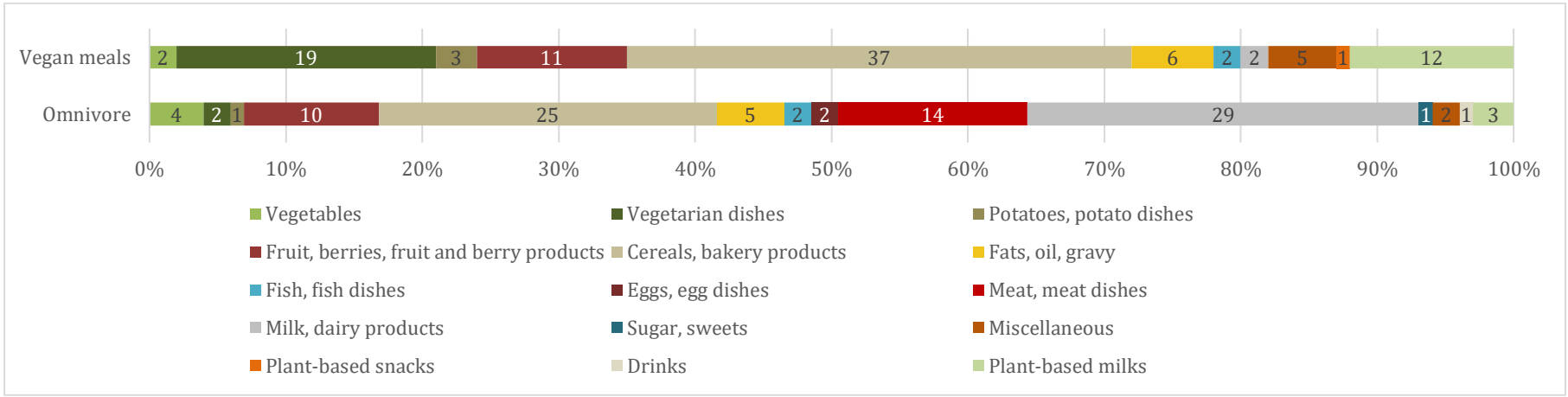

Figure 9. Energy sources among the vegan meals and omnivore group outside day-care, percent (%) of total consumption outside day-care.

Macronutrient sources

The most important food sources of protein for the children eating vegan meals were cereals, plant-based milks and vegetarian dishes (Figure 10). Among the omnivore children, they were milk, cereals and meat dishes (Figure 11). Among the children eating vegan meals at day-care fruit and vegetables made up 17% of the dietary fibre intake, while among the omnivore children this was only 8%. Plant-based milks make up one fifth of the dietary fibre intake among the vegan meals group. The second largest dietary fat source for the vegan meals group was vegetarian dishes while for the omnivore group it was meat and meat dishes.

Micronutrient sources

The main food sources for vitamin D in both groups are fat and plant-based or dairy milk, however, among the children eating vegan meals the fat category cover over half of the daily vitamin intake at the day-care (Figure 10, Figure 11). In the vegan meals group, fortified plant-based milks were the main source of dietary vitamin B12. The omnivore group had more varied sources, but dairy milk was predominant. Plant-based milk substitutes and cereals cover over 75% of folate intake in the vegan meals group. Among the omnivore children, roughly one third of the folate sources are animal based. In both groups milk, plant-based or dairy based, covered roughly three thirds of the dietary calcium intake of the children. Among the vegan meals group, the predominant food source for iodine was cereals. Dairy milk was the most important source for the omnivore children. For both the vegan meals and omnivore group, cereals were the most important iron source. Among the children eating vegan meals at day-care, the main food source of zinc were cereals and bakery products, followed by plant-based milks. The omnivore group had similar intakes from cereals and dairy milk, followed by meat.

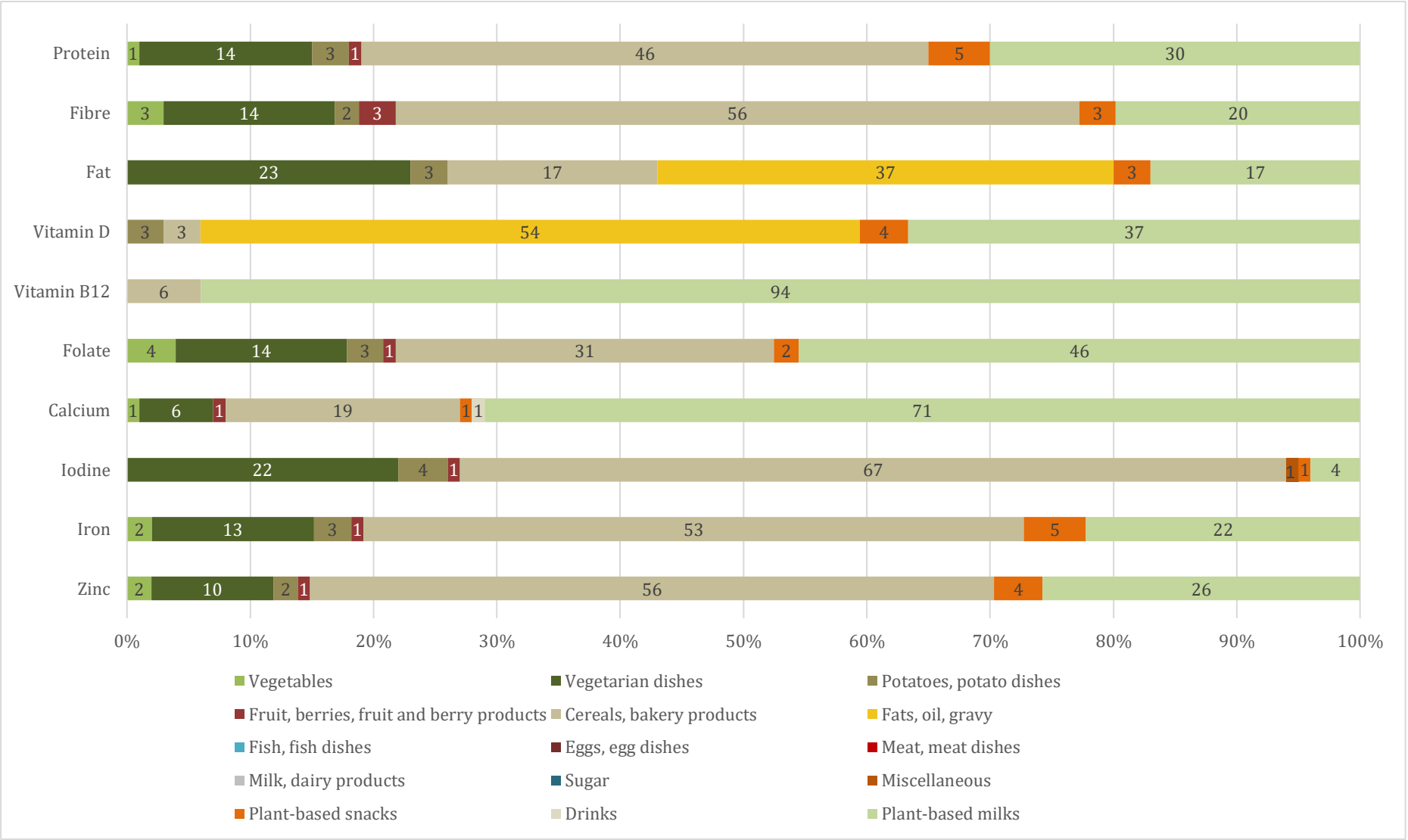

Figure 10. Nutrient sources at day-care of children eating vegan meals, percent (%) of total consumption at day-care.

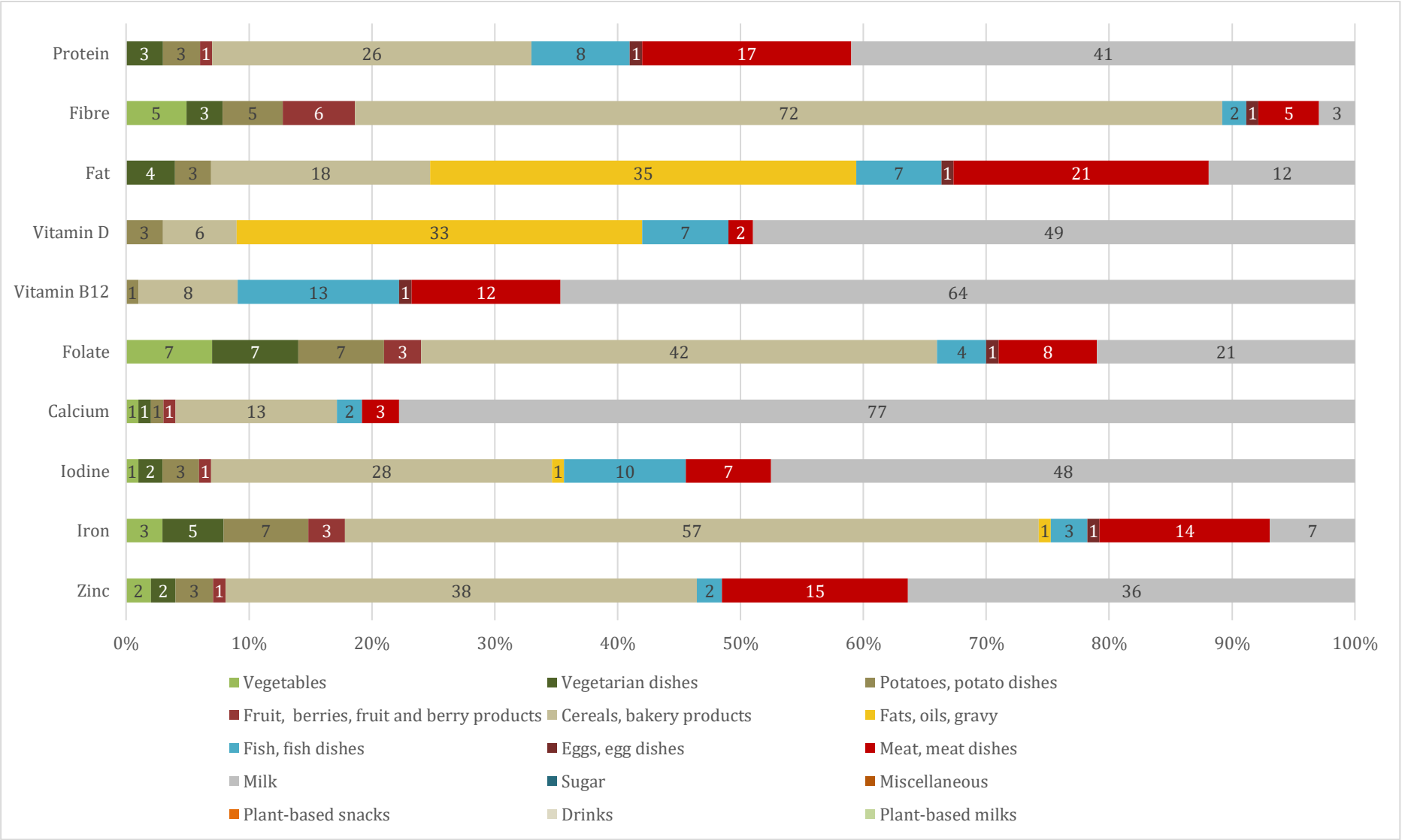

Figure 11. Nutrient sources at day-care of omnivore children, percent (%) of total consumption at day-care.

6. DISCUSSION

The aim of this study was to find out if there was a difference in dietary nutrient intake at day-care between children eating vegan or omnivore meals. The sources of selected nutrients and the division of dietary intake between the day-care and outside day-care were also described for both the vegan meals and omnivore group. In addition to these primary aims of this thesis, the results also describe how nutrient intake in the groups, both nutrient intake at day-care and including nutrient intake outside of day-care, fared with respect to official recommendations.

In the diet as a whole, the children in both groups had too low intakes of vitamin D and too high salt intakes compared to recommendations. Further, the omnivore group had too low iron intakes. Both at day-care and outside day-care the fat intake profile of the two groups was significantly different, with that of the children eating vegan meals being more in line with recommendations. Further, most micronutrient intakes differed significantly between the two groups. Dietary sources of selected nutrients differed between the groups with cereals and vegetables being more noticeable sources for dietary nutrients among the children eating vegan meals. Additionally, plant-based milks were a notably important source for many nutrients in the vegan meals group. Nutrient intake was in general equally divided between the day-care and outside day-care. However, a majority of the SAFA, cholesterol and vitamin C intake was outside the day-care.

6.1 Comparing results to previously published studies

As a vegetarian diet might contain dairy products, eggs, and fish, that all might have an important impact on the nutrient intake, the focus is to compare the results of this thesis with studies including vegan subjects. There are few studies available including young vegan children of similar age to the MIRA Helsinki study. In addition, studies done several decades ago might not be comparable with the results in this study, as the vegan diet has evolved and new products are on the market (11,19). As previously mentioned, the DAGIS study has published the most recent results of the diet of children in day-care in Finland (53). The DAGIS

study has divided the children in two age groups, the 3 to 4-year-old being the better comparison to the study sample of this thesis.

6.1.1 Overall dietary intakes

Among the omnivore children roughly half (54%) of the eaten food at home is plant-based and the diet at day-care is quite similarly divided (48% plant based). At day-care animal-based fat sources accounted for 41% of the dietary fat intake of the omnivore group, one fifth of the total fat intake was from meat and only 7% was from fish. Some omnivore children reported drinking plant-based milks outside day-care. There was also an increase in fruit and vegetable consumption outside day-care as compared to at day-care. This would indicate that the diet outside cay-care includes more plant-based options than at day-care. However, the meat consumption outside day-care was slightly higher. In contrast the fish consumption was lower outside the day-care.

Energy, protein and carbohydrates

The intake of energy was 5,8 MJ and 5,2 MJ in the vegan meals and omnivore group respectively. As the mean age of the children was 3,2 years an energy intake above 5 MJ is according to recommendations (51). The 3-4-year age group in the DAGIS study had a total energy intake of 5,6 MJ(52). A value between the two reported in this thesis. The protein intake of the omnivore group (18 E%) was similar to that reported in the DAGIS study (17 E%). The vegan meals at day-care group had a significantly lower intake at 13 E% which still is within the recommended range. Both carbohydrate and sucrose intakes were similar across both groups in this study and compared with the DAGIS study. The fibre intake among the omnivore children and the DAGIS study was similar, however, both were significantly lower than the intake of the children eating vegan meals at day-care (5,2 g/MJ). A Polish study comparing 2- to 10-year-old vegan and vegetarian children with omnivore children found no significant differences in macronutrient intake (E%) (40). However, this might be because the sample included different variations of vegetarian diets, and only a minority of vegans.

Fat and fat profile

The total daily fat intake for children eating vegan meals at day-care was 33 E% and 31 E% for omnivore children. In contrast, Weder at al. (11) found in a study of 1- to 3-year-old German children that vegans had a lower fat intake than omnivores, median 31 E% versus 36 E%. The total fat intake was similar across this thesis and the DAGIS study. However, the fat profile of the children eating vegan meals at day-care was significantly different from the omnivore group in this study and the intakes reported in the DAGIS study. The omnivore group and the DAGIS study sample similarly showed SAFA intakes above the upper limit and MUFA, PUFA, LA, and ALA intakes that barely reached the recommended levels. Additionally, the cholesterol intake of the omnivore group was similar to that reported in the DAGIS study. The cholesterol intake of Finnish 2- to 6-year-olds has been reported as 26 mg/MJ on average, which is in accordance with the intake among the omnivore children in this thesis, 25 mg/MJ (16).

Compared to these groups the children eating a vegan diet at day-care reported half the intake of SAFA, a fraction of the cholesterol intake, double the intake of PUFA, slightly higher intake of MUFA, and double the intakes of LA and ALA. These results show the positive characteristics of a vegan diet. However, the lack of DHA and EPA sources in a vegan diet is evident as intakes among the children eating vegan meals at day-care is only a third of the omnivore group. The fact that there is any dietary intake of these fatty acids is because three of the children in the group followed a vegetarian diet at home. The consumption of fish and dairy products outside the day-care is shown in the data of the children eating vegan meals at day-care. It is also noteworthy that the intakes of DHA and EPA varied greatly among both study groups, but especially in the vegan meals at day-care group. The intake of DHA in this group was 9,2 mg/MJ with a standard deviation of 27,6. The respective values in the omnivore group were 33,4 mg/MJ and 36,8. The higher ALA intake among the children eating vegan meals at day-care is very important as the body then produces both DHA and EPA from this precursor.

Micronutrients

The dietary intakes of vitamin C, vitamin B12 and zinc in both groups of this study were similar to the intakes reported by the DAGIS study (52). The intake of vitamin B12 exceeded the recommended intake by over 400 % among the children eating vegan meals at day-care, and over 500 % among the omnivore children. However, the intakes of vitamin A, vitamin D, iodine and salt were lower among the two groups in this study than in the DAGIS study. In contrast to

the DAGIS study, the children in this study did not reach the recommended intake of 10 µg of vitamin D. Of course, this thesis did not include supplements. The official recommendation is to supplement children's diet all year round (51). One-year-olds are recommended to take 10 µg supplements and 2 to 17-year-olds 7,5 µg. This additional intake of vitamin D would ensure that the children that do not reach the recommended dietary intake are not at risk of deficiency. The folate and calcium intakes of the omnivore group were comparable to those reported in the DAGIS study. However, the children eating vegan meals at day-care had a significantly higher folate intake of 357 µg and a significantly lower intake of calcium at 854 mg. Similar to the DAGIS study, the iron intake of the omnivore group was lower than the recommended 8-9 mg whereas the vegan meals group had a significantly higher intake of 12 mg. Additionally, the iodine intake of the omnivore group was significantly higher than that of the vegan meals group, though both reached recommended levels considering the mean age of the children. Also, both study groups exceeded the upper limit for salt intake which is cause for concern.

6.1.2 Dietary intake and sources at day-care

Energy intake and sources

Neither group reached the reference values of energy intakes at day-care, however, without further anthropometric measurements and growth follow-up it is impossible to say whether the intake was loo low or not. The energy intake at day-care of the vegan meals group was 2,8 MJ compared to 2,4 MJ in the omnivore group. There was no statistical difference in energy intakes at day-care between the groups. This is in line with results from a previous Finnish study comparing vegan and omnivore adults (19). However, the DAGIS study reported a higher energy intake of 3 MJ at day-care (52). The energy intake at day-care of the children eating vegan meals accounted for 48% of total intake, the corresponding value for the omnivore children was 46%. These values are similar to the 54% reported in the DAGIS study (52). Another source also indicate that the energy intakes at Finnish day-care centres do not reach two thirds of the daily recommended values (5). However, when all meals eaten throughout the day were included in this analysis the daily energy need is met. Similar results were reported in the DAGIS study (53).

Cereals and bakery products were the main source of energy in both groups, covering 42 % of the vegan meals group's intake and 37 % of the omnivore group's intake. The consumption of cereals and bakery products was reportedly lower in the DAGIS study, at 29 % of energy intake at day-care. The vegetarian dishes covered the same energy intake among the children eating vegan meals as meat and fish dishes among the omnivore children (17 %). The consumption of vegetarian dishes among the omnivore group was similar to that in the DAGIS study (52). Further, the consumption of plant-based snacks and milks were comparable to that of dairy products in terms of energy intake (21-22 %). The DAGIS study reported similar energy intakes from the consumption of milk and dairy products (52). Animal-based sources of energy were more dominant outside day-care than at day-care among the omnivore children. Even though some consumers report to have cut down on meat consumption, there are others who might even eat more than before (14,98). It is important to teach sustainable food habits to children at a young age and here the day-care and home share the responsibility.

Protein intake and sources

At day-care the omnivore children in this study had a higher protein than recommended reference values (84). These results are similar to other data on 1-year old Finnish children (62). Further, the DAGIS study showed very similar results in intakes at day-care as the omnivore children in this study, 17 E% compared to 19 E% (52). Significantly lower protein intakes were shown among the vegan meals group in this study but still within the reference values. The omnivore group had a higher than recommended intake of protein, with almost 70 % of that being animal-based. A 2008 study reported a similar intake of animal-based protein among Finnish 3-year-olds (16). By introducing more plant-based meals for all children at day-care the amount of animal-based protein from dairy and meat could be reduced. Cereal consumption covered only a fourth of protein intake among the omnivore children while, in contrast, being the main source of protein (46 %) among the children eating vegan meals. Plant-based snacks and milks combined were comparable to milk and dairy products as protein sources. Overall, the protein sources among the omnivore children mirrored those of the children in the DAGIS study (52).

Fat intake and sources

The children eating vegan meals had a significantly higher fat intake at day-care (34 E%) compared to the omnivore children (28 E%). Further, the fat intake of the omnivore children

was lower than recommended (84). All measured values of the fat profile in this thesis were significantly different between the children eating vegan meals and the omnivore children. Both MUFA and PUFA intakes as well as LA and ALA intakes were higher among the children eating vegan meals. As there were no dietary intakes of EPA and DHA in the vegan meals group, ALA serves as predecessor for the biosynthesis of these n-3 fatty acids. It is therefore important that sufficient amounts ALA is available. The vegan meals group had an intake of 2.6 E% ALA at day-care compared to 1.2 E% among the omnivore group. This is in contrast to an English study showing the lowest ALA intake among vegans compared to vegetarians and omnivores (59). The LA:ALA ratios of the children eating vegan meals and the omnivore children were very similar, both in total and at day-care the dietary intake ratio was 3:1. A lower ratio of LA:ALA aid the synthesis of DHA in the body, as the two fatty acids compete for conversion into long-chain fatty acids (60). This is more relevant for vegans and the omnivore children have higher dietary intakes from e.g. fish. The Finnish Nutrition Recommendations recommend a ratio of LA:ALA around 5:1, expressed as at least 3 E% LA and ALA, of which 0,5 E% ALA (55). The low ratio of LA:ALA of the vegan meals group in this study would not suppress conversion of ALA into DHA.

The fat intake of the omnivore children at day-care was 43 % of the daily total. This is lower than the 53 % reported in the DAGIS study (52). In the omnivore group as much as 60 % of the dietary SAFA and cholesterol intake is outside the day-care. However, the DAGIS study reports an equal division of SAFA intakes at day-care and outside day-care (52). Additionally, almost 60 % of ALA and EPA intake is at day-care. MUFA and PUFA intakes among the children eating vegan meals were equally divided between the day-care and outside the day-care. Meanwhile, the MUFA and PUFA intakes at day-care of the omnivore children were 45 % and 53 % respectively of the daily total. The DAGIS study showed the day-care having a larger contribution of 55 % of total MUFA and 61 % of total PUFA intakes (52). Further, the intake of SAFA compared to energy intake in the omnivore group in this thesis was clearly lower at day-care than outside day-care, dropping from 12 E% in the daily total intake to 9,0 E%. Similar results were seen for the cholesterol intake among the omnivore children, dropping from 25 mg/MJ in the daily total to 18 mg/MJ at day-care. These results indicate that the food at day-care has a beneficial impact on the fat profile of these children as the intake of the nutrients mentioned is not optimal.

The proportion of fat intake from the cereals and bakery products group as well as the fats, oil, and gravy group were comparable between the two groups. Whereas vegetarian dishes contributed almost a fourth of the fat intake in the vegan meals group, the same can be said for the combination of meat, fish and egg dishes in the omnivore group. The fat intake from the food groups meat and fish dishes in the omnivore group were similar to those in the DAGIS study (52).

Carbohydrate intake and fibre sources

Weder et al. (11) showed higher intakes of carbohydrates among vegan 1- to 3-year-olds (56 E%) than omnivore peers (50 E%). In the analyses in this thesis the intake was 50 E% in both groups at day-care, however in the daily total the omnivore group had an intake of 48 E%. The day-care centres contribution to total intake of carbohydrates and fibre were lower in this thesis compared to previously reported numbers in the DAGIS study (52). For example, this thesis reports an equal division of fibre intake between the day-care and outside the day-care in both groups while the DAGIS study reports 60 % of total fibre intake at day-care. However, the omnivore group had a significantly lower fibre intake. The fibre intake in the vegan meals and omnivore group was 5.3 g/MJ and 3.2 g/MJ, respectively. The higher fibre intake is beneficial for the gut but could also negatively impact micronutrient absorption.

Cereals were the main source of dietary fibre in both groups, 56% of the intake among children eating vegan meals and 72% of the intake among omnivore children. This is in line with an earlier Finnish study that found roughly 65% of dietary fibre intake at day-care centres was from cereals (52). Korkalo et al. (52) further found that crispbread consumption alone accounted for one-fifth of the fibre intake among the children. Further, fruit and vegetable consumption accounted for roughly another fifth (19%) of the dietary fibre intake at day-care centres in the DAGIS study. Results from this thesis found fruit and vegetables to be similarly important dietary fibre sources among the children eating vegan meals (17%), but among the omnivores, these groups accounted for only 8% of dietary intake. A study showed that on average fruit was served 2.5 times a week in day-care centres in Southern and Western Finland (89). Day-care centres and/or municipalities with more food-related polices put in place were associated with a higher fruit and vegetable consumption at day-care. More effort would be needed to encourage the day-care centres to serve more fruit and vegetables to the children. Additionally, plant-based snacks and milks distinguished themselves again as an important

nutrient source among the children eating vegan meals at day-care, covering over a fifth of their fibre intake.

The omnivore and vegan meals group had similar sucrose intakes at day-care, consisting of 47 % of the daily total among the vegan meals group and 44 % of the daily total among the omnivore group. The DAGIS study reports a slightly lower number of 41 % of total daily sucrose intake at day-care (52). A study from 2002 showed that cookie, chocolate and candy consumption among adolescent vegans was lower than among omnivores (38). However, with so many new products on the market today, it could be hypothesized that the differences in eating behaviour between a vegan and an omnivore does not need to be so different. Convenience foods and snacks are not necessarily excluded from a vegan diet and therefore all the health benefits of a vegan diet are not a given.

Vitamin D intake and sources

In Finland, dietary vitamin D intake is of special importance as biosynthesis could be insufficient in the northern latitudes (73). Compared to the recommendations, both groups had too low total dietary vitamin D intakes. This finding is supported by previous studies among young Finnish toddlers and children (53,62). A Polish study also showed low dietary vitamin D intakes among vegetarian, vegan, and omnivore children aged 2-10 years (40). Additionally, intakes at day-care in the current study were just below the suggested two thirds of the recommended daily intake, covering 57% of the need of the children eating vegan meals at day-care and 63% of the omnivore children. The omnivore children's intake at day-care is similar to the 68 % reported in the DAGIS study (52). Fortified margarine and plant-based milks were the most important dietary sources of vitamin D for the children eating vegan meals. Fats alone covered 54% of their intakes at day-care. Roughly half of the omnivores' vitamin D intakes were from dairy milk and a third from fats. Compared to the omnivore group, the consumption of fat covered a bigger portion of vitamin D intake in the DAGIS study (43 %), while milk and dairy product consumption covered less (44 %) (52). Fish consumption covered 7% of vitamin D intake among the omnivores in this thesis, which is comparable to the DAGIS study.

Vitamin B12 intake and sources

Vitamin B12 intakes at day-care greatly exceed recommendations in both the vegan meals (200 %) and omnivore (250 %) group. This is similar to a 1988 UK study showing intakes 280 %

higher than recommendations (42). In the results of the current study supplements have not been included. When fortified products are included in the vegan diet, vitamin B12 intakes seem to be of no issue even without supplementation. However, due to the importance vitamin B12 plays in early childhood development it's a continuous priority to safeguard the requirements of this vitamin. The day-care is responsible for half of the omnivore group's intake which is comparable to the DAGIS study (52). The same value is 42 % of total intake in vegan meals group. Nearly all (94%) of the vitamin B12 intake at day-care came from fortified plant-based milks in the vegan meals group. Omnivore children got roughly two thirds from dairy milk and a fourth from fish, eggs, and meat. These values are comparable to those reported in the DAGIS study (52).

Vitamin C intake

The intake of vitamin C does not significantly differ between the groups and therefore the sources of this vitamin will not be described. However, a higher consumption of fruits and berries was reported among the omnivore children (40 g) compared to the children eating vegan meals (30 g). Nonetheless, the intake of vitamin C at day-care is low in both groups, vegan meals group 38% and omnivore group 32% of total intake, compared to the intake of other micronutrients ranging between 41-67% of total intake. This is in contrast to the DAGIS study that found vitamin C intake to be equally divided between the day-care and outside day-care (52). However, that the vitamin C intake at day-care is low is in accordance with findings from another study done in Finnish day-cares (99). The study concluded that there was a low availability of fruit in the day-cares and almost half of the early educators thought that the children were not served enough fruits and berries. To include more fruits would be beneficial both for the children's nutritional intakes and their future food behaviour. Therefore, the reasons for the low fruit consumption should be investigated and addressed so that fruit could be made more available in day-cares.

Vitamin A intake

The children eating vegan meals at day-care had a higher intake of vitamin A at day-care, even though not statistically significantly. While the vegan meals group got a majority of the vitamin A intake at the day-care (60 %), the omnivore group only got around 40% of daily total intake at day-care. This would explain how in the diet as a whole the omnivore group had higher

vitamin A intakes. In contrast, the DAGIS study showed that half of the daily vitamin A intake came from the meals at day-care (52).

Folate intake and sources

The folate intake of the children eating vegan meals was significantly higher than that of the omnivore children. Further, the intake of folate is equally divided between the day-care and outside the day-care. Data from the DAGIS study show the meals at day-care provide slightly more, 56 % of folate intake (52). At day-care, plant-based milk consumption was the main source of folate among the vegan meals group, accounting for 46 % of the intake at day-care. In contrast, cereals and bakery products accounted for the main source (42 %) in the omnivore group. This was also the case in the DAGIS study, where this food group contributed to slightly less (35 %) of folate intake (52). Milk and dairy products contributed to a fifth of folate intake among both the omnivore children and the children involved in the DAGIS study. Even though the dietary intakes of folate reported in this thesis are above recommendations, the folate status of the children should be confirmed through biometric tests.

Calcium intake and sources

Calcium intakes in the vegan meals and omnivore group exceeded recommendations and were equally divided between the day-care and outside the day-care. The day-care was shown as a higher contributor in the DAGIS study, responsible for 57 % of daily calcium intake (52). However, the omnivore children did have a significantly higher calcium intake. As the bioavailability of calcium from plant-based sources is significantly lower it is especially important for vegan children to have a high dietary intake. In contrast to the results in this thesis, the vegan and vegetarian children in a Polish study did have calcium intakes below recommendations and low calcium intakes have been associated with negative effects on bone health (40). The main source for dietary calcium at day-care was plant-based milks in the vegan meals group (71 % of total intake at day-care), and milk and dairy products in the omnivore group (77 % of total intake at day-care). The importance of milk and dairy products as a calcium source is comparable to the results of the DAGIS study (52). However, among both the vegan meals and omnivore group cereals and bakery products were more important calcium sources than reported in the DAGIS study.

Iron intake and sources

The day-care was responsible for roughly half of the dietary iron intake of both groups in this data, compared to 57 % in DAGIS data (52). The children eating vegan meals did have adequate iron intakes, while the omnivore children were slightly below the recommended values. As the plant derived non-heme iron is less easily absorbed in the human body, the higher dietary iron intakes do not necessarily mean that the vegan meals group has more bioavailable iron. However, it has previously been shown that iron intakes among Finnish omnivore toddlers and children are below recommendations (53,62). Previous studies have also shown that iron deficiencies are equally prevalent among vegan, vegetarian and omnivore participants especially among teenage women (38,65). This would indicate that iron is a critical nutrient, especially for young children and adolescents, regardless of diet. Cereals were the main source of iron in both groups, covering 53 % of the intake of children eating vegan meals and 57 % of the omnivores. Similar results were found in the DAGIS study and among Swedish vegan adolescents (49,52). The phytate in the bread adds a further negative effect on the absorption of the non-heme iron so the bioavailable iron could be even lower. In the vegan meals group plant-based snacks and milk contributed with over a fourth of the iron intake at day-care. The iron intake from consumption of meat, fish, and eggs among the omnivore children was similar to that of the children in the DAGIS study (52).

Zinc intake and sources

The dietary intake of zinc at day-care among the children eating vegan meals at day-care is 45 % of total intake. The same value for the omnivore children is 47 % which still is lower than the 56 % reported in the DAGIS study (52). The children eating vegan meals at day-care have significantly lower intakes than the omnivore children. Further, the zinc sources in the omnivore group are more versatile. Over half of the vegan group's intake comes from cereal and bakery product consumption while the same sources only cover 38 % of intakes at day-care among the omnivore group. The DAGIS study reports similar intakes from cereals and bakery products as the omnivore group (52). Additionally, the omnivore children's consumption of meat and fish dishes cover 17 % of zinc intake at day-care, compared to 22 % in the DAGIS study. Intakes of zinc from plant-based snack and milks among the children eating vegan meals are only slightly lower than intakes from dairy products among the omnivore children, 30 % and 36 % respectively. This is similar to the 31 % reported in the DAGIS study. These results further show the value of fortified plant-based products, such as milks, in the diet of vegan children.

Iodine intake and sources

The children in both groups got almost 60 % of iodine intake at day-care which is comparable to the results of the DAGIS study (52). The main sources of iodine differed between the groups. Among the children eating vegan meals cereals and bakery product consumption covered 67 % of intake at day-care, while vegetarian dishes covered another 22 %. In contrast, the main source for the omnivore children was milk and dairy products covering 48 % of intakes at day-care. Further, cereals covered only 28 %, and meat and fish dishes another 17 % of iodine intake among the omnivore children. The iodine sources of the omnivore children and their importance were comparable to the results of the DAGIS study (52).

Salt intake

The day-care was responsible for 57 % of salt intake among the vegan meals group, and 52 % of intake among the omnivore group. The DAGIS study reports a proportion of salt intake at day-care similar to that of the vegan meals group (52). When comparing absolute intakes at day-care the salt intake in the vegan meals group was higher than in the omnivore group. In fact, 74 % and 69 % of the daily upper limit of salt intake had been consumed in the vegan meals and omnivore group respectively. However, when adjusted for energy intake the salt intake in the omnivore group is higher by 0,1 g/MJ. The reason for the slightly higher absolute salt intake in the vegan diet is mainly due to a higher energy intake. Possibly the use of processed foods such as falafels as substitutes for home cooked animal-based main dishes could be another explanation but is not further explained in this thesis. It is important to tackle this unnecessarily high salt content in both the vegan and omnivore food at day-care, so the children don’t get accustomed to higher salt levels in foods.

6.2 Evaluation of methodology

6.2.1 Sample size and generalisation of results

Families that had requested vegan meals at the day-care centres were specifically targeted in the MIRA Helsinki study and the fact that 80 % agreed to take part show that the efforts were worthwhile. However, in the end barely 30 % of all children eating vegan meals at day-care

were included in this thesis. The sample is therefore not completely representable of the group. Additionally, the participation rate for the omnivore group was low. Barely 20 % of the invited families agreed to take part. The sample size for the MIRA Helsinki study (N= 60) was modest to begin with. By further narrowing the data to fit the inclusion criteria of this thesis (n= 25), the natural variation between individuals will have had a larger effect on the results than in a larger study sample.

As participation in the MIRA Helsinki study was voluntary this could attract families that are more invested and knowledgeable of their children's diets and nutrition than the average. This is true for both groups. The burden of keeping a food diary and filling out several questionnaires might have deterred some families from taking part. This is an added challenge in studying young children as it requires the active participation of a parent or guardian. However, the participants that did agree to take part might have been more committed to completing the study.

As most Finnish children attend day-cares run by the municipality this study focuses on what can be seen as the norm of day-care children (87). Highest attendance at day-care are between 2-6 years of age, with a peak at five years. This corresponds to the sample of this thesis where the children were between one and six years of age, with an average age of 3,2 years. However, the participants in this study are from the city of Helsinki where food behaviour is different than in areas outside the big cities. This can be seen by the prevalence of vegetarianism among children at day-care being 2 % in the metropole area of Helsinki and only 0,6 % in more rural areas (17,18). Therefore, the results cannot be generalised for Finland as a whole, but only for Helsinki.

6.2.2 Evaluation of study methods

Food diaries

A food diary gives a detailed record of the consumed food and beverages and the open-ended method suited this study sample well. Any special products used in the diet of the vegan children or at day-care could be reported with sufficient detail (95). As dietary intakes may vary over a period of time, it is important to record the diet over a sufficient amount of time. Nutrient sources that are consumed on a daily basis have a lower variation than others that are consumed

more seldom but in bigger portions (95). Additionally, the variance of dietary nutrient intake in children's diets could be higher than in the diet of an adult depending on the child's age and how similar their diet is to that of the rest of the family (100). However, multiple recording days are quite demanding on the subjects and too many days might negatively affect the quality of the gathered data (91). A seven-day food diary would be recommended to estimate both macro- and micronutrient intakes of young children (101). Nonetheless, in this study this would put an excessive strain on both the parents and the early educators that functioned as substitutes for the young children (100). It is important to not overburden the adults with too demanding research protocols to ensure they follow through (11). Also, in a smaller sample, it is more cost-effective to increase the number of days per individual instead of the number of subjects (95). Knowing that the number of vegan children in day-care in Helsinki was not large, the MIRA Helsinki study did well to choose a multi-day food diary. A four- to five-day food record can be seen as an acceptable compromise between statistical evidence and realistic load on participants (95).

Underreporting might not necessarily be a source of bias in studies with young children. Instead guardians tend to over report the amount eaten by their young children (102,103). The guardians might unintentionally want to report a healthier diet and they might have difficulties differentiating between the offered and the eaten food. In this thesis the food diaries at day-care were mostly used. The early educators could have similar tendencies to over report just like the guardians. Further, the commitment and motivation of the early educators for taking part in the study could vary considerably (100). The validation study for the Children's Food Picture Book used in the MIRA Helsinki study showed that portion sizes were similarly evaluated by both early educators and parents (92).

Bias

As previously stated, the voluntary nature of the MIRA Helsinki study may have skewed the profile of the families enrolling in both groups. More health-conscious families might have signed up, which could have had an effect on the results of this thesis. The variety in data entry between researchers was minimised by the standardising of the data entry procedures mentioned in the method chapter. Finally, the fact that I myself am a vegan since more than 10 years could have an impact on my ability to view and interpret the data objectively. I have strived to be objective in my analyses and writing but I am not above reproach.

6.2.3 Strengths and weaknesses of the study

Strengths

There is very little scientific data on vegan under school-aged children and none from Finland. The results of this study give a first insight into the dietary intakes of this group. Further, this study focuses on the food served at day-care, which gives more information about the nutritional quality of these meals both for children eating vegan and omnivore meals. Geographically the data is gathered in day-care centres in the Helsinki region, which means the results are targeted specifically for this area. Another strength is the data collection method. Multiday food diaries are a reliable way to record dietary intakes and, in this case, they also allowed participants to detail any special products used.

Weaknesses

A weakness is that not all the children in the vegan meals group were true vegans. This will have an effect on the results as animal products consumed at home will affect the results. However, no nutritional status has been measured and the focus of the research questions was the dietary intake of nutrients at day-care. The impact was minimised by excluding the omnivore children eating vegan meals at day-care. Their presumably larger consumption of animal products could have noticeably affected the results. As the groups were small to begin with, the children were not further divided according to age or sex. This would have made statistical analysis more unreliable. The studies available of vegan children and adolescents, and even adults, are quite small. These heterogeneous samples have varied intakes and show that some vegans have good food habits while others do not (38). In such a small study sample for this thesis, the impact of a heterogeneous sample is larger. However, the focus is on the meals served at day-care, so the variety of meals served at home has a smaller impact on overall diet.

6.3 Importance of the study and looking forward

This thesis aims to analyse the data from the MIRA study in respect of how adequate the offered vegan food is in the day-care centres in Helsinki. This is of interest as there are few studies on

the diets of young vegans in Finland, and the characteristics of their diet could be of use when discussing benefits and risks.

The testing period of offering vegan food at selected day-care centres in Helsinki ended in 2017. In September of 2017, the researchers wrote a statement on whether the municipality should continue to offer vegan food at day-care. Stating the lack of knowledge of a vegan diet's effect on the nutrition and health of children the researchers based the statement on the preliminary results from the still ongoing MIRA Helsinki study. The researchers concluded that most parents requested a vegan diet for their true vegan child based on ethical beliefs and that no child should be without food at day-care. If an ethical conviction was seen as a sufficient reason by the municipality of Helsinki, the researchers stated that the option of a vegan diet should continue to be available to children also eating a vegan diet at home. Researchers added that it is the responsibility of the family to make sure that appropriate dietary supplementations are included in the diet. In 2018 the municipality of Helsinki took the decision to offer the option of a vegan diet at all day-care centres, provided that the child also followed the diet at home. It is fully possible to provide nutritious vegan food to children and this would be necessary to help secure adequate dietary intakes. A study showed that if adolescent vegan Swedes and Norwegians did not like the food at school, they tended to substitute it with sweets or skip lunch altogether (47). It is important that young vegans are supported and provided with tasty and nutritious food.

The investment into a well-planned and balanced diet for children is worth making, as chronic diseases caused by lifestyle choices are getting more and more common and risk factors start accumulating in childhood (84). More vegetarian food on the menus at day-care could have beneficial effects (52). A well-planned vegan diet is beneficial both for health reasons and for the environment. On a global level, a form of semi-vegetarian diet is viewed as the sustainable diet of the future (104). A healthier diet, together with more sustainable food production and less food waste are seen as the readily implementable actions. Canada's Dietary Guidelines released in January 2019 lead with the message to base your diet on plant-based protein (105). The guidelines made a change in grouping dairy and meat together in protein sources without highlighting them. This type of acknowledgement that a healthy diet can be composed without animal protein can be seen as a reflection of today's society. A semi-vegetarian diet is mentioned as an excellent way to eat healthily and sustainably. However, for ethical vegans there is no middle ground. A German study showed that more than half of the parents with a 1-

3-year-old vegan child were mainly motivated by ethical reasons (11). However, as society is moving more towards a flexitarian diet, there will naturally be more vegan options available e.g. at day-care centres. A lot of planning and attention to detail goes into the vegan meals offered in the day-care centres. However, there is no nutritional benefit from food that is not eaten. In this study there were some children who only eat a vegan diet at day-care, and this could mean that the foods being offered are less familiar and therefore less to the child's taste. Familiarity and presentation are factors that can impact how willing a child is to try the food. More studies would be needed on if the impact of preference would negatively affect the dietary intakes of omnivore or vegetarian children eating vegan meals.

There are numerous studies focused on a vegetarian diet in all stages of life. More studies would be needed about a vegan diet, especially focusing on young children and the long-term implications of the diet. Many studies to date often add vegans and vegetarians to the same group, making it hard to differentiate the potential different effects of the two. The results and conclusions drawn from this study with such a small sample size should be confirmed in a larger sample. There is a need for larger studies to be done among pre-school aged vegan children in Finland. Longitudinal studies could truly show the long-term effects of a vegan diet from early childhood onwards.

7. CONCLUSIONS

Dietary intakes differed significantly between the two groups. Nonetheless, in most cases dietary intake followed the official recommendations. Incorporating more vegetarian meals into the meal planning would beneficially impact the omnivore children's fat profile and protein intake. However, the fat profile of the food served at the day-care centres had a positive impact on the total diet of the omnivore children. Total salt intake in both groups was too high and is an area of concern. In the diet of the children eating vegan meals at day-care, fortified plant-based milk played a central role as a source of many nutrients.

A vegan diet may result in lower intakes of certain nutrients; however, deficiencies can be avoided by planning the diet appropriately and taking the special needs of a growing child into consideration. A vegan diet has many positive characteristics and it seems a challenge may be that the vegan diet today is more similar to an omnivore diet in the use of convenience and processed foods. This could result in similar struggles with e.g. high salt intake. This study was not representative enough to draw broader conclusions on the benefits or risks of a vegan diet for children. Longitudinal studies on vegan children are scarce and more evidence is needed on the long-term effects on a growing child.

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Attachment 1.

MIRA Helsinki -tutkimus

RUOKAPÄIVÄKIRJA Tutkittavan tunnus: | | | | | | | | |

Täytetään kotona Lomake tarkistettu: |

Lapsen nimi: _____

Ruokapäiväkirjan täyttäjä: _____ puhelinnumero: _____

Ruokapäiväkirjaa pidetään valintasi mukaan yhtenä tai kahtena päivänä.

Valitse päivät, joina lapsi ei ole päivähoidossa, jotta pystyt kirjaamaan kaiken päivän aikana syödyn ruoan ja juoman.

Otathan yhteyttä, jos on kysyttävää: Liisa Korkalo, 050 5849781 (liisa.korkalo@helsinki.fi)

Mitä ruokapäiväkirjaan kirjataan?

- Ruokapäiväkirjaan kirjataan kaikki lapsen muualla kuin päiväkodissa syömät ruoat, juomat ja ravintovalmisteet sekä niiden määrät mahdollisimman tarkasti.
- Vain lapsen syömät ruoat ja juomat sekä niiden määrät kirjataan. Syömättä jäänyttä ruokaa ei kirjata.
- Hoitaja merkitsee päiväkotiaikana syödyt ruoat ja juomat erilliselle lomakkeelle päiväkodissa.

Mihin tulisi kiinnittää huomiota?

- Maidon, juuston, paistorasvan, leivänpäällysrasvan, lihan, kalan ja leikkeleiden kohdalla kirjataan elintarvikkeen tuotemerkki ja rasvapitoisuus (esim. *”rasvaton maito, Arla Ingman, 1,5 dl”*; *”margariini, Keiju 60 %, 1 tl”* tai *”keittokinkku, 2,5 %, HK, 1 viipale”*).
- Valmiista eineksistä ja kaupassa myytävistä valmisruoista ja leivonnaisista ym. kirjataan valmistaja ja kauppanimi tai ostopaikka (esim. *”hernekeitto, Saarioinen, 2 dl”* tai *”berliininmunkki, Fazerin paistopiste, 1 kpl”).*
- Luomutuotteiden kohdalle kirjataan *”luomu”*.
- Kotona tehdyistä ruoista kirjataan kaikki raaka-aineet ja niiden laadut (esim. *”jauheliharisotto: naudan jauheliha (17 % rasvaa), täysjyväriisi, lihaliemi, rypsiöljy, herne-maissi-paprikasekoitus, mustapippuri, paprikajauhe, merisuola”)* sekä valmistustapa (esim. *”keitetty”*, *”paistettu uunissa”*, *”paistettu pannulla”* tai *”uppopaistettu”* eli friteerattu öljyssä).
- Käytetyistä ravintovalmisteista kirjataan valmisteen nimi ja käyttömäärä (esim. *”Moomin D-vitamin 10 mikrog Xylitol-Strawberry, 1 tabletti”*).

Miten ruoan määrää arvioidaan?

- Voit käyttää ruoan määrän arvioimisessa apuna annoskuvakirjaa ja sen kuvakoodeja (esim. *”siskonmakkarakeitto, 79 b”* tai *”banaani, puolikas kuvasta 28 c”*).
- Syödyn ruoan määrän voi arvioida myös talousmittoina (tl, rkl, dl) tai grammoina, jos tiedon saa helposti pakkauksesta. Pihvien, leipien, hedelmien ja kasvisten kokoa voi arvioida senttimetrimittojen avulla (esim. *”porkkanapala, 1 cm x 1 cm x 5 cm”*).
- Leipä-, juusto- ja kinkkuviipaleita, hedelmiä, lihapullia, kalapuikkoja ym. voi arvioida myös kappaleina (esim. *”näkkileipä, Koululainen, 1 kpl”* tai *”omena, keskikokoinen, ½ kpl”*).

Miten ruokapäiväkirja vaikuttaa normaaliin elämään?

- Niinä päivinä, joina pidetään ruokapäiväkirjaa, tulisi syödä mahdollisimman tavanomaisesti. Ruokapäiväkirjan pitämisen ei tulisi vaikuttaa siihen, mitä ruokia ja milloin lapselle tarjotaan.
- Juhlat ja muut tapahtumat, esimerkiksi syntymäpäivät, ovat osa normaalia elämää, eivätkä ole este ruokapäiväkirjapidolle.
- Ruokapäiväkirjaan on hyvä tehdä merkinnät syömisen yhteydessä tai välittömästi sen jälkeen.
- Illalla on hyvä tarkistaa, että kaikki ateriat (myös välipalat ja naposteltavat) on kirjattu ruokapäiväkirjaan.

Esimerkki ruokapäiväkirjan täytöstä:

Viikonpäivä: *perjantai* Päivämäärä: *7.4.2017*

Kellonaika	**Ruokailupaikka**	**Ruoat, juomat ja ravintovalmisteet, niiden laatu (+ kauppanimi) ja raaka-aineet**	**Syöty määrä mahdollisimman tarkkaan (annoskuvakirjan koodi tai tl, rkl, dl, g tai kpl)**
7.30	*Koti*	*Nalle neljän viljan puuro (vesi, hiutaleet, ei lisättyä suolaa)*	*39 b*
		Pakastemustikoita	*37 a*
		Sokeria	*2 tl*
		Luomu-kevytmaitoa, Valio	*1 b*
		Kaurakorppu, Oululainen	*½ kpl*
		Margariini, Keiju, 70 %	*11 b*
		Gouda, Arla, 17 %	*14 c*
		Satsuma, keskikokoinen	*½ kpl*
		Nallekarkki, Haribo	*92 a*
		D-vitamiinivalmiste, Minisun D3, mangonmakuinen	*1 tabletti (10 mikrog)*
16.15	*Mummola*	*Makaronilaatikko (makaroni, naudan jauhelihaa (17 %*	*54 b*
		rasvaa), sipuli, Pansuola, paprikajauhe,	
		kananmunaa, Luomu-kevytmaitoa, oliiviöljyä paistamiseen)	
		Ketsuppi, Pikku Myyn luomuketsuppi	*1½ x 75 c*
		Kurkku	*17 b*
		Salaatinkastike (oliiviöljy, viinietikka, suola, hunaja, mustapippuri)	*0,5 tl*
		Xylitol-pastilli, Herra Hakkarainen	*1 kpl*
		Täysmaito, Valio	*1 b*
19.30	*Koti*	*Jacky Jugupala vadelma-vanilja*	*1 prk*
		Carneval Prinsessa -keksi	*1 kpl*
		Marli Vital Herukka + kuitua –mehujuoma	*2 c*
20.30	*Koti*	*Grillimakkara, Urho*	*1½ kpl*
		Ketsuppi, Pikku-Myyn luomuketsuppi	*3 rkl*
		Leipä, Vaasan iso vehnäpaahto	*1 kpl*
		Rasvaton maito, Arla Ingman	*1 c*
		Valio Kidius Gefilus jogurtti banaani HYLA	*125 g*

Viikonpäivä: _____ Päivämäärä: _____

Kellonaika	**Ruokailupaikka**	**Ruoat, juomat ja ravintovalmisteet, niiden laatu (+ kauppanimi) ja raaka-aineet**	**Syöty määrä mahdollisimman tarkkaan (annoskuvakirjan koodi tai tl, rkl, dl, g tai kpl)**

Attachment 2.

MIRA Helsinki -tutkimus
ESITÄYTETTY RUOKAPÄIVÄKIRJA
Täytetään päiväkodissa

Tutkittavan tunnus: | | | | | | | | |

Lomake tarkistettu: | |

Lapsen nimi: _____
Päiväkoti ja ryhmä: _____

Lomakkeen täyttöpäivät: |__|__| / |__|__| / |__|__|__|__| **Viikonpäivä:** _____
|__|__| / |__|__| / |__|__|__|__| **Viikonpäivä:** _____
|__|__| / |__|__| / |__|__|__|__| **Viikonpäivä:** _____
pv kk vuosi

Päiväkirjaa täyttäneiden hoitajien nimet ja puhelinnumerot:
_____, puhelinnumero: _____
_____, puhelinnumero: _____

Järjestettiinkö päiväkodissa ruokapäiväkirjan pitopäivinä tilaisuuksia, joissa ruokailu poikkesi normaalista?
Ympyröi yksi tai useampi vaihtoehto.

a) Kyllä, syntymäpäiväjuhlia
b) Kyllä, vuodenaikaan liittyviä juhlia (esim. Runebergin päivä, pääsiäinen, vappu tai itsenäisyyspäivä)
c) Kyllä, retkiä tai vierailuja
d) Kyllä, jokin muu tilaisuus, mikä? _____
_____
e) Ei

Ohjeita ruokapäiväkirjan täyttämiseen

- Ruokapäiväkirjan merkinnät kannattaa tehdä syömisen yhteydessä tai välittömästi aterioinnin jälkeen.
- Ruokapäiväkirjaan merkitään vain ne aterian osat, jotka lapsi on syönyt.
- Jos lapsi ei ole ollut läsnä jollain aterialla, merkitään selkeästi, että lapsi ei osallistunut aterialle.
- Rivien loppuessa tai sopivan rivin puuttuessa ruoka tai juoma kirjataan riville ”Muut”.
- Määrien arvioinnissa voi käyttää annoskuvakirjaa, talousmittoja (tl, rkl, dl) tai painoa (g). Ruoan määrän voi ilmoittaa myös kappaleina (esim. hedelmät, lihapullat, kalapuikot ym. kokonaisina tarjottavat elintarvikkeet).
- Muista kirjata mausteet (esim. ketsuppi, sokeri tai hillo), salaatinkastikkeet, leivänpäälliset, juomat (myös muulloin kuin aterioilla nautitut) ja jälkiruoat.
- Seuraavalla sivulla on esimerkki ruokapäiväkirjan täyttämisestä.

Jos on kysyttävää, soita Essi Skaffari, 050 448 0706 (essi.skaffari@helsinki.fi)
tai Liisa Korkalo, 050 5849781 (liisa.korkalo@helsinki.fi)

Esimerkki ruokapäiväkirjan täyttämisestä

Päivämäärä: *7.4.2017* **Viikonpäivä:** *perjantai* **Klo:** *11.00*

LOUNAS	**Ruoat ja juomat**	**Syöty määrä (dl, rkl, tl, g, kpl)**
Pääruoka	*Jauhelihakastike*	*63 a*
	Lisäannos jauhelihakastiketta	*63 a*
Lisukkeet	*Peruna, keskikokoinen*	*2 x 45 b*
	Lisäannos perunaa	*1 x 45 b*
Salaatit	*Porkkanaraaste*	*23 a*
	Jäävuori-raejuustosalaatti	*puolikas kuvasta 23 a*
Kasvikset, hedelmät ja marjat		
Leivät ja leivänpäälliset	*Näkkileipä*	*puolikas kuvasta 5 b*
	Margariini	*11 a*
Juomat	*Rasvaton maito*	*1 c*
	Vesi	*1 b*
Maustekastikkeet ja mausteet	*Ketsuppi*	*75 a*
Muut		

Klo: *14.20*

MUU RUOKAILU	**Ruoat ja juomat**	**Syöty määrä (dl, rkl, tl, g, kpl)**
Ruoat	*Syntymäpäiväkakku*	
	(kermatäytekakku, marjatäyte)	*85 a*
Juomat		
	ei juonut mitään	

Päivämäärä: **Viikonpäivä:** **Klo:**

AAMIAINEN	**Ruoat ja juomat**	**Syöty määrä (dl, rkl, tl, g, kpl)**
Puurot, vellit ja niiden lisukkeet		
Leivät ja leivänpäälliset		
Kasvikset, hedelmät ja marjat		
Rahkat, viilit ja jogurtit		
Murot ja myslit		
Juomat		
Muut		

Klo:

LOUNAS	**Ruoat ja juomat**	**Syöty määrä (dl, rkl, tl, g, kpl)**
Pääruoka		
Lisukkeet		
Salaatit		
Kasvikset, hedelmät ja marjat		
Leivät ja leivänpäälliset		
Juomat		
Maustekastikkeet ja mausteet		
Muut		

Päivämäärä: **Viikonpäivä:** **Klo:**

VÄLIPALA	**Ruoat ja juomat**	**Syöty määrä (dl, rkl, tl, g, kpl)**
Leivät ja leivänpäälliset		
Puurot ja niiden lisukkeet		
Kiisselit ja mehukeitot		
Rahkat, viilit ja jogurtit		
Kasvikset, hedelmät ja marjat		
Murot ja myslit		
Juomat		
Muut		

Klo:

MUU RUOKAILU	**Ruoat ja juomat**	**Syöty määrä (dl, rkl, tl, g, kpl)**
Ruoat		
Juomat		

Attachment 3.

Table S1. Average intake of energy and macronutrients at day-care of both vegan meals and omnivore group, median (min-max). Comparison done with the Mann-Whitney U test.

	Intake/day		P-value for difference[1, 2]
	Vegan meals	Omnivore	
Energy, MJ	2,6 (2,1-3,5)	2,5 (0,9-4,3)	
kcal	628,4 (498,5-830,01)	595,7 (217,5-1034,1)	ns
Protein, g	21,5 (12,0-28,3)	27,9 (12,6-52,5)	
E%	11,4 (8,5-16,0)	19,3 (11,4-24,8)	**
Carbohydrates, g	82,2 (59,8-112,2)	75,5 (28,2-115,3)	
E%	47,2 (46,0-64,0)	48,6 (42,4-58,5)	ns
Sucrose, g	11,0 (6,5-18,9)	9,1 (2,1-19,6)	
E%	6,6 (5,1-11,1)	7,0 (1,4-15,1)	ns
Fibre, g	15,6 (9,2-19,9)	8,3 (2,3-12,9)	
g/MJ	5,5 (4,4-6,4)	3,0 (2,2-4,6)	**
Fat, g	22,8 (18,0-33,8)	18,8 (5,1-36,0)	
E%	34,6 (25,4-37,1)	29,4 (17,6-35,2)	**
SAFA, g	4,5 (3,2-6,0)	6,0 (1,8-11,0)	
E%	6,0 (5,3-7,5)	9,6 (4,4-15,5)	**
MUFA, g	7,8 (7,2-13,5)	6,7 (1,6-13,7)	
E%	12,8 (10,6-14,7)	10,4 (6,1-13,6)	**
PUFA, g	7,7 (4,8-11,1)	3,7 (0,8-8,1)	
E%	11,7 (6,8-12,6)	5,3 (2,6-7,6)	**
LA, g	5,8 (4,1-8,0)	2,5 (0,5-5,0)	
E%	8,6 (5,8-9,3)	3,5 (1,3-5,2)	**
ALA, g	1,7 (1,4-3,0)	0,8 (0,2-1,7)	
E%	2,6 (1,9-3,2)	1,2 (0,5-1,8)	**
Cholesterol, mg	0,6 (0,05-0,8)	39,1 (14,2-89,4)	
mg/MJ	0,2 (0,02-0,4)	16,4 (8,8-30,2)	**
Trans fat, g	0,1 (0,04-0,1)	0,2 (0,04-0,4)	
E%	0,1 (0,07-0,2)	0,2 (0,07-0,6)	**
EPA, g	0	0,01 (0-0,2)	
E%	0	0,02 (0-0,3)	**
DHA, g	0	0,03 (0-0,5)	
E%	0	0,05 (0-0,8)	**

1. * p> 0,05; ** p< 0,01
2. ns= non-significant (p> 0,05)

Table S2. Average intake of micronutrients at day-care of both vegan meals and omnivore group, median (min-max). Comparison done with the Mann-Whitney U test.

	Intake/day		P-test for difference [1, 2]
	Vegan meals	Omnivore	
Vitamin C, mg	20,7 (11,7-36,0)	23,0 (10,2-38,8)	
mg/MJ	8,5 (3,4-12,7)	8,7 (5,4-13,3)	ns
Vitamin A, ug RE	296,7 (166,1-422,3)	184,1 (62,5-389,1)	
ug/MJ	115,9 (63,2-160,8)	79,2 (45,5-156,2)	ns
Vitamin D, ug	5,7 (2,5-8,1)	5,9 (2,4-11,6)	
ug/MJ	2,1 (1,2-2,6)	2,5 (1,8-3,6)	*
Vitamin B12, ug	1,8 (0-3,2)	2,1 (0,8-3,5)	
ug/MJ	0,6 (0-1,1)	0,8 (0,3-1,3)	*
Folate, ug	170,4 (77,1-228,9)	72,9 (28,4-156,6)	
ug/MJ	63,7 (37,0-79,0)	31,6 (21,5-39,8)	**
Calcium, mg	424,0 (92,5-725,1)	549,5 (271,6-953,0)	
mg/MJ	159,0 (44,4-240,8)	228,8 (112,6-353,3)	*
Iodine, ug	53,8 (25,8-99,4)	111,5 (51,0-226,4)	
ug/MJ	21,7 (9,8-29,1)	48,4 (28,5-56,0)	**
Sodium, mg	1054,2 (306,7-1653,1)	1048,0 (367,8-1778,5)	
mg/MJ	409,0 (116,6-484,5)	401,8 (217,3-479,0)	ns
Iron, mg	5,8 (3,8-7,8)	3,7 (1,0-6,5)	
mg/MJ	2,2 (1,8-2,5)	1,4 (1,0-1,8)	**
Zinc, mg	3,7 (2,0-5,4)	4,2 (1,7-6,7)	
mg/MJ	1,3 (1,0-1,7)	1,7 (1,3-2,4)	**

1. * p> 0,05; ** p< 0,01
2. ns= non-significant (p> 0,05)

Table S3. Average total daily energy and macronutrient intake of both vegan meals and omnivore group, median (min-max). Comparison done with the Mann-Whitney U test.

	Intake/day		P-value for difference [1, 2]
	Vegan meals	Omnivore	
Energy, MJ	5,5 (5,0-6,7)	5,2 (3,4-7,3)	
kcal	1318 (1182-1611)	1244 (815-1737)	ns
Protein, g	46,2 (26,5-55,0)	57,8 (35,1-72,8)	
E%	13,4 (8,6-15,2)	17,9 (11,8-23,9)	**
Carbohydrates, g	161,8 (140,7-208,4)	154,0 (81,2-189,4)	
E%	48,7 (43,3-58,3)	48,7 (40,5-54,1)	ns
Sucrose, g	22,1 (13,4-46,2)	24,1 (8,9-52,3)	
E%	7,0 (3,6 -11,7)	7,7 (3,6-17,6)	ns
Fibre, g	28,7 (24,5-38,7)	16,1 (6,8-25,9)	
g/MJ	5,4 (3,9-6,4)	2,9 (1,4-5,5)	**
Fat, g	51,1 (41,7-68,2)	42,3 (24,6-72,7)	
E%	33,6 (27,1-39,8)	31,3 (19,9-39,0)	ns
SAFA, g	9,0 (8,0-21,1)	14,7 (7,3-29,0)	
E%	6,0 (4,5-12,3)	11,4 (5,9-16,9)	**
MUFA, g	19,1 (15,9-26,1)	14,7 (7,5-24,2)	
E%	13,3 (9,6-15,2)	10,4 (6,1-13,4)	*
PUFA, g	16,2 (8,5-19,3)	6,9 (2,9-11,0)	
E%	10,6 (6,0-12,3)	4,6 (3,1-7,6)	**
LA, g	12,1 (7,1-14,0)	4,5 (2,0-9,4)	
E%	7,7 (5,0-9,2)	3,2 (1,6-6,6)	**
ALA, g	3,7 (2,0-4,3)	1,5 (0,4-2,6)	
E%	2,2 (1,4-3,0)	1,0 (0,3-1,5)	**
Cholesterol, mg	1,1 (0,5-70,4)	112,4 (46,2-226,2)	
mg/MJ	0,2 (0,1-11,1)	23,6 (9,9-56,5)	**
Trans fat, g	0,1 (0,06-0,7)	0,5 (0,3-1,3)	
E%	0,08 (0,03-0,4)	0,4 (0,2-0,7)	**
EPA, g	0 (0-0,2)	0,03 (0,0002-0,2)	
E%	0 (0-0,1)	0,03 (0,0001-0,1)	**
DHA, g	0 (0-0,5)	0,1 (0,005-0,6)	
E%	0 (0-0,3)	0,09 (0,003-0,4)	**

1. * p> 0,05; ** p< 0,01
2. ns= non-significant (p> 0,05)

Table S4. Average total daily micronutrient intake of both vegan meals and omnivore group, median (min-max). Comparison done with the Mann-Whitney U test.

	Intake/day		P-value for difference [1, 2]
	Vegan meals	Omnivore	
Vitamin C, mg	55,4 (35,3-95,8)	70,6 (31,3-154,5)	
mg/MJ	9,4 (7,2-15,4)	13,6 (6,7-31,6)	ns
Vitamin A, ug RE	456,4 (358,4-694,1)	498,1 (300,1-1067,8)	
ug/MJ	85,1 (65,6-111,7)	98,4 (64,1-200,4)	ns
Vitamin D, ug	8,9 (5,1-12,3)	9,7 (4,5-14,0)	
ug/MJ	1,6 (0,8-1,9)	1,8 (1,2-2,6)	ns
Vitamin B12, ug	3,5 (0,9-6,4)	3,9 (1,9-8,3)	
ug/MJ	0,6 (0,2-1,0)	0,7 (0,4-1,6)	ns
Folate, ug	318,5 (262,7-499,1)	160,7 (107,4-233,3)	
ug/MJ	58,8 (49,9-91,4)	31,5 (22,5-44,3)	**
Calcium, mg	849,0 (578,7-1192,4)	1103,2 (579,8-1521,9)	
mg/MJ	153,9 (93,2-187,8)	205,4 (112,8-285,6)	**
Iodine, ug	96,7 (59,8-141,9)	181,0 (124,7-277,3)	
ug/MJ	15,6 (10,9-23,8)	34,9 (24,3-46,7)	**
Sodium, mg	2005,8 (1135,0-2369,1)	1801,5 (982,0-2665,8)	
mg/MJ	337,2 (216,5-382,7)	343,9 (259,1-443,9)	ns
Iron, mg	12,0 (10,8-15,1)	7,6 (4,4-12,5)	
mg/MJ	2,1 (1,9-2,5)	1,3 (1,1-2,4)	**
Zinc, mg	10,2 (5,4-13,0)	9,2 (5,2-11,1)	
mg/MJ	1,5 (1,0-2,5)	1,7 (1,2-2,0)	ns

1. * p> 0,05; ** p< 0,01
2. ns= non-significant (p> 0,05)

Attachment 4.

Table S5. Summary of dietary energy and nutrient sources per food group at day-care in vegan meals and omnivore group (vegan meals / omnivore).

	Energy (MJ)	Protein (g)	Fibre (g)	Fat (g)	Vitamin D (µg)	Vitamin B12 (µg)	Folate (µg)	Calcium (µg)	Iodine (µg)	Iron (mg)	Zinc (mg)
Vegetables	0,49 / 0,10	3,1 / 0,9	2,4 / 0,6	5,7 / 0,8	0 / 0	0 / 0	29 / 11	32 / 12	13 / 3	0,9 / 0,3	0,4 / 0,2
Vegetarian dishes	0,46 / 0,08	2,9 / 0,7	2,0 / 0,3	5,6 / 0,8	0 / 0	0 / 0	24 / 5	24 / 5	13 / 3	0,8 / 0,2	0,3 / 0,1
Potatoes, potato dishes	0,12 / 0,14	0,6 / 0,9	0,3 / 0,4	0,9 / 0,5	0,1 / 0,2	0 / 0	4 / 5	2 / 7	2 / 3	0,2 / 0,2	0,1 / 0,1
Fruit and berries, fruit and berry products	0,07 / 0,11	0,2 / 0,2	0,4 / 0,5	0,1 / 0,1	0 / 0	0 / 0	2 / 3	3 / 4	0 / 1	0,1 / 0,1	0 / 0
Cereals, bakery	0,12 / 0,90	9,1 / 6,9	8,2 / 5,6	4,2 / 3,3	0,2 / 0,4	0,1 / 0,2	51 /32	80 / 71	41 / 30	3,2 / 2,0	2,0 / 1,6
Fats, oils, gravy	0,34 / 0,25	0 / 0	0 / 0	9,2 / 6,5	3,1 / 2,1	0 / 0	0 / 0	1 / 1	0 / 1	0 / 0	0 / 0
Fish, fish dishes	0 / 0,12	0 / 2,2	0 / 0,1	0 / 1,3	0 / 0,5	0 / 0,3	0 / 3	0 / 10	0 / 11	0 / 0,1	0 / 0,1
Eggs, egg dishes	0 / 0,01	0 / 0,2	0 / 0	0 / 0,1	0 / 0	0 / 0	0 / 1	0 / 1	0 / 1	0 / 0	0 / 0
Meat, meat dishes	0 / 0,30	0 / 4,6	0 / 0,4	0 / 3,9	0 / 0,1	0 / 0,2	0 / 6	0 / 15	0 / 8	0 / 0,5	0 / 0,6
Milk, dairy products	0,01 / 0,53	0 / 11,0	0 / 0,3	0 / 2,2	0 / 3,1	0 / 1,3	0 / 16	0 / 413	0 / 52	0 / 0,2	0 / 1,5
Sugar, sweets	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Miscellaneous	0,14 / 0	0,9 / 0	0,4 /0	0,7 / 0	0,2 / 0	0 / 0	4 / 0	4 / 0	1 / 0	0,3 / 0	0,1 / 0
Plant-based snacks and desserts, plant-based cream	0,13 / 0	0,9 / 0	0,4 / 0	0,7 / 0	0,2 / 0	0 / 0	4 / 0	4 / 0	1 / 0	0,3 / 0	0,1 / 0

Continuation of Table S5.

	Energy (MJ)	Protein (g)	Fibre (g)	Fat (g)	Vitamin D (µg)	Vitamin B12 (µg)	Folate (µg)	Calcium (µg)	Iodine (µg)	Iron (mg)	Zinc (mg)
Drinks	0,44 / 0	6,1 / 0	2,9 / 0	4,3 / 0	2,1 / 0	1,5 / 0	77 / 0	307 / 2	3 / 0	1,4 / 0	0,9 / 0
Plant-based milks and drinks	0,44 / 0	6,1 / 0	2,9 / 0	4,3 / 0	2,1 / 0	1,5 / 0	77 / 0	305 / 0	3 / 0	1,4 / 0	0,9 / 0
Mean intake	2,75 / 2,45	19,9 / 26,8	14,7 / 7,8	25,0 / 18,8	5,7 / 6,3	1,6 / 2,0	168 / 77	429 / 536	61 / 109	6,1 / 3,5	3,6 / 4,1